

The Impact of the Space Environment on Space Systems

20 July 1999

Prepared by

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This technical report has been reviewed and is approved for publication. Publication of this report does not constitute Air Force approval of the report's findings or conclusions. It is published only for the exchange and stimulation of ideas.

A handwritten signature in black ink, reading "Hal Hagemeyer", is written over a horizontal line.

Col. Hal Hagemeyer, Chief
Integration Division
National Security Space Architect

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13. ABSTRACT (Maximum 200 words) We have undertaken a study to determine the impact of the space environment on space systems. Known impacts include mission outages, mission degradation and mission failure, launch delays, redesign and retest, anomaly analyses, and the ultimate cost for each of the preceding. We are attempting to quantify these impacts whenever possible. This task is made difficult because impacts are rarely formally documented. We reviewed a variety of sources for anomaly impact information. These sources include anomaly reports from the archives of the Space Sciences Department of The Aerospace Corporation and other organizations, written and oral information from other staff members of The Aerospace Corporation, and contractor reports and published documents relating to spacecraft anomalies. The study provides a good indication of the quality and quantity of the data available. It also shows the degree to which it is possible to obtain impact information for historical anomalies. We summarize the results of the study, and emphasize those causes for which it may be possible to provide predictive information such as surface charging, internal charging, and the single-event upsets that accompany solar proton events.				
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1. Introduction

We have undertaken a study to determine the impact of the space environment on space systems. We have included all types of spacecraft for which we have been able to find data. These include commercial, scientific, and military—both US domestic and foreign.

Known impacts include service outages, mission degradation and mission failure, data loss, sensor degradation, subsystem failure, launch delays, redesign and retest, anomaly analyses, and the ultimate cost for each of the preceding. We have attempted to quantify these impacts whenever possible. This task is made difficult because impacts are rarely formally documented.

2. Sources of Data

A variety of databases were used to determine those spacecraft anomalies that have been attributed to the space environment. The following comprehensive databases were utilized:

- (1) Spacecraft Anomaly Manager (SAM). This database was maintained until recently by NOAA/NGDC in Boulder, Colorado. This database primarily contains anomalies that are believed to have been caused by the space environment.
- (2) The Orbital Data Acquisition Program (ODAP). This database was developed by The Aerospace Corporation. It is no longer maintained. It contains anomaly information on 15 US Air Force and 91 non-Air Force programs. It was primarily developed to identify hardware reliability problems.
- (3) NASA Anomaly Reports [*Bedingfield et al.*, 1996; *Leach and Alexander*, 1997].
- (4) The anomaly database maintained by the US Air Force 55th Space Weather Squadron.

There are a number of serious difficulties with these existing anomaly databases. The databases were designed to determine the extent of spacecraft problems from the standpoint of the spacecraft designer. One of their main uses has been to identify unreliable parts across a variety of different spacecraft and manufacturers. Although in some cases they identify the environment as the cause of an anomaly, the spacecraft generally lack sensors to determine the state of the environment at the location of the spacecraft at the time of an anomaly. Since the appropriate environmental data were not available at the spacecraft, it was often difficult to make a diagnosis with high confidence that an anomaly was caused by the space environment. The assessments that have been incorporated into the data records have been made by a large number of people, some of whom are experts in environmental anomaly diagnosis, and some of whom have little knowledge or training in this area. Thus, there is a great deal of variability in the quality of the assessments that have been made.

The databases are also poorly maintained. There is no formal mechanism for collecting or submitting data to the organizations that maintain the databases. Often after an anomaly is understood it is no longer considered an anomaly and may no longer be recorded in the database. In the case of ODAP, later instances of an anomaly type on the same vehicle were often listed in the comment field of the first instance. Thus, there is no way to accurately count or even estimate the number of occurrences of a given type of anomaly on even a single spacecraft from the existing databases.

Finally, the databases were found to be completely inadequate to perform this study because they contain virtually no information on the impact of the anomalies in the sense that we are studying them. For both technical and insurance reasons the problems and impacts associated with anomalies are often closely held by the responsible organizations and are not normally released to the public.

A new database, known as the Space Systems Engineering Database (SSED), is being developed by The Aerospace Corporation. It is essentially a modern replacement for ODAP and addresses many of the problems found in the earlier databases. It currently contains data for several hundred vehicles.

3. Approach Used for this Study

We have augmented the databases above with a number of other sources for this study. We have reviewed the anomaly reports from the archives of the Space Sciences Department of The Aerospace Corporation to summarize the anomaly investigations that have been undertaken by the members of the department. In some cases, the original source material mentions the impacts the anomalies have had, especially if they have led to a redesign of a spacecraft subsystem. We have also contacted people whom we have worked with on anomaly analyses to obtain written and oral information regarding those studies. Contractor reports, published journal articles, newspaper articles, and memos have also been reviewed to identify anomaly investigations and impacts. We also visited NOAA/NGDC and reviewed their anomaly files for anomaly impacts.

We have summarized the data collected for this study in a Space Environment Impact Database. Each record contains the information for one class of anomalies for one vehicle. An anomaly class is a set of anomalies with essentially similar observables. This data collection can not and should not be used as an anomaly database for counting the individual occurrences of anomalies because each anomaly is not documented in a unique record. One record may document one anomaly or, in the extreme case, 617 anomalies for the main-bus, under-voltage, and phantom commands caused by surface electrostatic discharges on the MARECS-A spacecraft. The Space Environment Impact Database contains a description of the anomaly class, the diagnosis (i.e., the environmental cause), an indication as to whether or not the diagnosis was supported by the material in the references (on a scale from 3 meaning the diagnosis was well supported to 0 meaning there was no information to support the diagnosis), a description of the impact, any relevant comments from the references or the compiler, and a list of the references from which the information was obtained. The data have been entered into a Microsoft Access database to facilitate gathering statistics for this report. The complete database is included in Appendix A. The references for the source material for the database are given in Appendix B.

4. Results

The Space Environment Impact Database for this study contains 326 records. The number of records by spacecraft affiliation is given in Table 1. The total count in that table is greater than 326 because some of the spacecraft fall under more than one affiliation, such as foreign, commercial, communication satellites. 299 of the records contain anomalies that have the cause diagnosed as the space environment. Of these 299, only 155 have impacts obtained from the referenced documents.

Virtually none of the impacts are quantified in terms of their cost. Nor are their descriptions of the effects on the ultimate user of the space system. This is understandable because none of the information was provided by the ultimate user. Most of the information in the available sources was provided by the operators and the vehicle manufacturers. Hence, it tends to be related to operator impacts such as time required to restore the vehicle to normal operation or to technical impacts such as the testing and redesign required to "fix" the next generation of vehicles.

Table 1. Distribution of Records in the Space Environment Impact Database by Affiliation

Affiliation	Number of Records
DoD	87
Foreign	63
NASA, NOAA	58
Scientific	57
Classified/Other	52
Commercial	51

4.1 Anomaly Diagnosis

The distribution of records by anomaly diagnosis is given in Table 2. The first group is electrostatic discharges (ESD) and charging. The ESD anomalies group contains the largest number of records: 162. Virtually all of the anomalies in this area result from discharges. Only one was caused by the voltage changes on the surface of the vehicle. The uncategorized ESD anomalies refer to those that were not identified as either internal discharges or surface discharges in the references.

The second largest number of records, 85, falls in the Single-Event Upsets (SEU) group, also shown in Table 2. It contains less than half the number of records as the ESD group. The uncategorized SEU anomalies refer to those that were not related to cosmic rays, solar proton events, or the South Atlantic Anomaly in the references. Of these, the largest class is probably due to cosmic rays, and the smallest to solar proton events.

A distant third, with 16 records, is the radiation damage group. The largest member of this group is solar-array degradation, which is only reported as an anomaly when an unusually large degradation occurs during a solar proton event. Total radiation dose anomalies are surprisingly infrequent, repre-

Table 2. Distribution of Records by Anomaly Diagnosis

Diagnosis	Number of Records
ESD - Internal Charging	74
ESD - Surface Charging	59
ESD - Uncategorized	28
Surface Charging	1
Total ESD & Charging	162
SEU - Cosmic Ray	15
SEU - Solar Particle Event	9
SEU - South Atlantic Anomaly	20
SEU - Uncategorized	41
Total SEU	85
Solar Array—Solar Proton Event	9
Total Radiation Dose	3
Materials Damage	3
South Atlantic Anomaly	1
Total Radiation Damage	16
Micrometeoroid/Debris Impact	10
Solar Proton Event—Uncategorized	9
Magnetic Field Variability	5
Plasma Effects	4
Atomic Oxygen Erosion	1
Atmospheric Drag	1
Sunlight	1
IR background	1
Ionospheric Scintillation	1
Energetic Electrons	1
Other	2
Total Miscellaneous	36

senting only 1% of the records. This probably reflects the conservative limits defined in the radiation models and the conservative approach applied by designers when specifying shielding limits for electronic components.

Twelve other miscellaneous causes amounted to only 36 records.

4.2 Impacts

The only impact that could be readily quantified is the time required for the operators to recover from an anomaly. This may be taken as the duration of the impact on the user. This impact usually represented complete loss of data or service for the duration. The durations shown in Table 3 are the lengths of time that were required to restore service to the users. It is interesting to note that it is tri-modal with peaks at *Minimal*, *One Hour to One Day*, and *More Than One Week*.

Table 3. Distribution of Records by Impact Duration

Duration of Impact	Number of Records
Minimal	13
Less than 10 min	8
10 min to 1 hr	14
1 hr to 1 day	54
1 day to 1 wk	7
More than 1 wk	68
Mission loss	9
Unknown	153

A *Minimal* duration anomaly has essentially no impact on the users. Some anomalies caused by SEUs are in this category because many spacecraft are designed to detect such anomalies and perform an automatic recovery. Anomalies in housekeeping functions, such as temperature sensors, are also in this category because they have no impact on the user.

One hour to One day represents the time it takes to recover, for example, when a vehicle suffers an attitude-control anomaly or enters a safe-hold condition. *More Than One Week* includes permanent damage and failures.

Table 4 lists other identifiable impacts that have happened on a number of systems. The largest number of records is 70 for *Phantom Commands*. The most serious is the *System or Part Failure* category, which occurs in 53 or 16% of the cases.

Table 4. Other Impacts

Impact	Number of Records
Phantom Command	70
Degraded Performance	55
System or Part Failure	53
Upsets	47
Other or Unknown	47
Spurious Signal	24
Solar array Degradation	14

Solar Array Degradation refers to the loss of solar array power capability primarily due to radiation damage of the solar arrays during a solar proton event. In most cases, the impact given in the source material was the potential loss of mission lifetime. However, there was no follow up to determine whether this shortening of the mission actually occurred. Thus, it was not possible to determine whether this impact was ultimately real or only predicted.

4.3 Mission Loss

Table 5 lists those missions that were listed as mission losses in the reference material and for which the diagnosis was environmental. Because of the impossibility of making a definitive diagnosis remotely and the serious repercussions of a mission loss, there is usually considerable controversy

Table 5. Missions Lost or Terminated Due to the Space Environment

Vehicle	Date	Diagnosis
DSCS II (9431)	Feb 73	Surface ESD
GOES 4	Nov 82	Surface ESD
Feng Yun 1	Jun 88	ESD
MARECS A	Mar 91	Surface ESD
MSTI	Jan 93	Single Event Effect
Hipparcos*	Aug 93	Total Radiation Dose
Olympus	Aug 93	Micrometeoroid Impact
SEDS 2*	Mar 94	Micrometeoroid Impact
MSTI 2	Mar 94	Micrometeoroid Impact
IRON 9906	1997	Single Event Effect
INSAT 2D	Oct 97	Surface ESD

* Mission had been completed prior to termination

surrounding the cause of each mission loss. For the most part, the diagnoses listed have been identified as probable causes by experts on space environmental anomalies who have been involved in the analyses of anomalies on those vehicles.

The largest cause of mission failures related to the space environment is Surface ESD. In all cases, those vehicles were in geosynchronous orbit.

5. Space Weather Forecasting

Spacecraft charging ESD has caused by far the most environmentally related anomalies on spacecraft, and surface charging has caused the most serious anomalies, i.e., those that have resulted in the loss of the mission. Unfortunately, it is much more difficult to forecast the location and seriousness of spacecraft surface charging than it is to forecast the location and seriousness of internal charging.

Internal charging occurs one to a several days after a major magnetic storm. Hence, the storm itself is a warning that high levels of energetic electrons may be present in the radiation belts in the near future. Since these electrons primarily diffuse inward after the storm, their progress could be monitored, and flux levels reasonably well predicted one to two days in advance. Efforts to do this have been undertaken using linear prediction filters and neural networks [Nagai, 1988; Baker *et al.*, 1990; Koons and Gorney, 1991; 1993].

Surface charging is much more difficult to predict. It not only requires a prediction of a magnetic storm or substorm but also the electron distribution function as a function of location in the magnetosphere. Surface charging is not necessarily related to the absolute intensity of the flux of hot electrons around the spacecraft, but rather to the details of the electron distribution function. For example, the worst-case surface-charging event on the SCATHA spacecraft on 22 September 1982 occurred at a time when the electron distribution function at low energies (<1 keV) was below average, at middle energies (1 to 10 keV) was near the top of its average range, and at high energies (20 to 100 keV) was above its average range [Koons *et al.*, 1988; Roeder, 1994]. It is likely that the combination of high fluxes in the higher-energy range combined with a reduction in the secondary electrons from primaries in the low-energy range caused the extreme surface charging conditions on that day. Since surface charging occurs on a much faster time scale than internal charging, only an imminent forecast is probably possible, and it is unlikely that the location can be accurately identified without a significant number of sensors located across the tail of the magnetosphere.

Only the SEUs related to solar proton events can be forecast, and only an imminent solar proton event can be expected to be forecast in the foreseeable future. Since these SEUs represent only about 10% of the SEU Space Environment Impact Records, forecasts of solar proton events will not have a significant effect on impacts caused by SEUs.

Similarly, solar array degradation due to radiation damage of the arrays during a solar proton event will not have a significant effect on environmental impacts. This effect is further reduced because the time remaining in the mission is not necessarily related to this degradation, but is more often caused by some other failure on the vehicle.

Other causes make up a small portion of the environmentally related anomalies, and many, such as total radiation dose, atomic oxygen erosion, micrometeoroid impact, and debris impact, are inherently nonpredictable.

6. Recommendations

We recommend that significant efforts be made to better specify the electron distribution functions responsible for surface charging and internal charging. It is especially important to obtain the worst-case environments in the spirit of the 100-year storm used by civil engineers to design dams and flood control systems. With such specifications and with studies of the interactions of these environments with candidate spacecraft materials, the spacecraft designer will be better able to design spacecraft that are immune to the environment.

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Appendix A

Space Environment Impact Database

Name: A-1

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☒ **Foreign:** ☐

Dates: 08 Mar 94

Description: Burnout of circuit

Diagnosis: ESD **Sure:** 2

Impact: Unknown **Duration:** Unknown

Category: Random Part Failure

Comments: Satellite within Field Aligned currents combined with enhanced 51-1540 keV electrons before and during anomaly time

References: SWS1

Name: A-2

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☒ **Foreign:** ☐

Dates: 03 Apr 94

Description: Bit flip in attitude control software

Diagnosis: SEU **Sure:** 0

Impact: Unknown **Duration:** Unknown

Category: Other

Comments: Strong electron and proton disturbances near anomaly time

References: SWS1

Name: ADE0S 1

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☒

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: 24 Sept 1996

Description: Safehold; computer glitch

Diagnosis: SEU-Cosmic Ray **Sure:** 0

Impact: Based on description **Duration** 1 hr to 1 day

Category: Phantom commands

Comments: None

References: JEM1, JHA22

Name: ALEXIS

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☒

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: ?

Description: Autonomous attitude control system failed;

Diagnosis: Unknown **Sure:** 0

Impact: Necessitated creation of a makeshift attitude control system. s/c operators need to upload a file each time a maneuver is desired **Duration** Unknown

Category: System Failure

Comments: None

References: JHA23

Name: AMPTE/CCE

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☒

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 11 Sep 1984 on

Description: The magnetometer changed modes on 4 occasions

Diagnosis: SEU **Sure:** 0

Impact: Operating procedures had to be changed to remain operational **Duration** 1 hr to 1 day

Category: Phantom commands

Comments: None

References: RSS51

Name: AMPTE/CCE

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☒

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 11 Nov 1984

Description: Lost data modulation due to phantom command

Diagnosis: ESD **Sure:** 0

Impact: Operating procedures had to be changed to remain operational **Duration** Unknown

Category: Phantom commands

Comments: None

References: RSS13

Name: AMPTE/CCE

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☒

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: Apr 1988

Description: The Command Processor system (CPS) No. 1 failed

Diagnosis: Total Radiation Dose **Sure:** 0

Impact: Switch to CPS No. 2 by the operators **Duration:** Unknown

Category: System Failure

Comments: Failure of CMOS PROM caused by cumulative radiation damage over 3.5 years in orbit

References: RSS50

Name: Anik B

Commercial: ☒ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: 8 Feb 1986

Description: Roll error, occurred twice

Diagnosis: Magnetic Field Variability **Sure:** 0

Impact: Roll control was maintained, using thrusters if necessary **Duration:** 1 hr to 1 day

Category: Other

Comments: Reaction of electromagnetic torquing control coils to a large geomagnetic disturbance

References: RSS38

Name: Anik B1

Commercial: ☒ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: After Dec 1978

Description: One minor anomalous switching event.
significant increase in operating temperature
of various components. Thermal surfaces
were degraded

Diagnosis: ESD Surface **Sure:** 0

Impact: Unknown **Duration** Unknown

Category: Phantom commands

Comments: Localized discharges when the satellite was
in eclipse

References: RSS12

Name: Anik D2 (later ARABSAT 1D)

Commercial: ☒ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: 8 Mar 1985

Description: The despin control system malfunctioned and the platform on which the communications antenna was mounted began to spin, interrupting data transmission

Diagnosis: ESD Surface **Sure:** 0

Impact: Although the satellite was eventually brought under control, fuel was used to correct the resulting wobble and a year of station keeping was lost. Also, a greater than expected degradation to mirrored surfaces was attributed to surface discharges in the thermal blanket **Duration** More than 1 wk

Category: Phantom commands

Comments: A large arc-discharge originating on the reflector at the back of the antenna or on the thermal shield at the front of the antenna

References: RSS12

Name: Anik E1

Commercial: ☒ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: 20 Jan 1994

Description: Momentum wheel control circuits failed causing satellite to point away from the Earth

Diagnosis: ESD Internal **Sure:** 3

Impact: Eight hour loss of service. 56 TV channels and data and telephone service in northwestern Ontario, northern Quebec, the Northwest Territories and the Yukon **Duration:** 1 hr to 1 day

Category: System Failure

Comments: Internal discharges from an ungrounded spot shield. Full service was restored about 8 hours after the failure by successfully switching the momentum wheel control circuit to a backup on-board redundant circuit

References: HCK11, HCK12, HCK13, HCK14, HCK18, HCK28, RSS3, RSS4

Name: Anik E1

Commercial: ☒ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: 26 March 1996

Description: The 'south array' of solar power panels effectively disconnected from the battery charging system

Diagnosis: ESD Internal **Sure:** 1

Impact: Anik was reduced to half its customary power supply. This resulted in immediate loss of transponder capability which could only be partially compensated by operators after some hours. Reduction by about two-thirds of its communication throughput capacity **Duration** Unknown

Category: System Failure

Comments: '..., it appears very probable that the high fluence of energetic electrons was related to the failure.'

References: HCK9, JHA9

Name: Anik E2

Commercial: ☒ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: 20 January 1994

Description: Main momentum wheel energy transfer control circuit and secondary back-up failed during same event. Burnout of CD4047 Monostable/A stable Multivibrator from ungrounded spot shield

Diagnosis: ESD Internal **Sure:** 3

Impact: Canadian Press, the countries biggest news service wasn't able to transmit data for more than seven hours to more than 100 newspapers and 400 radio stations. TV and Radio relay of CBC broadcasts were eliminated by the failures. Satellite valued at US\$228.8 million **Duration** 1 hr to 1 day

Category: System Failure

Comments: Engineers devised a ground based control system using the satellite's thruster motors to bring the satellite under control on 21 June and restore it to useful service in August. Five month effort and \$15M loss to company. Service life of satellite shortened by 1 year

References: HCK11, HCK12, HCK13, HCK14, HCK16, HCK18, RSS3, RSS4, JHA21

Name: Arabsat 1A

Commercial: ☒ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: 15 Mar 1985, 1 Jun 1986

Description: On 15 March lost power, attitude control and orbit gyros. On 1 June loss of Earth lock in the attitude control system

Diagnosis: ESD **Sure:** 0

Impact: Manual North-South station keeping, **Duration** 1 day to 1 wk

Category: Other

Comments: Arab league communications satellite

References: RSS7,RSS11

Name: ATS 6

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☒

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: After May 1974

Description: The heat pipe gas reservoir ran hotter than normal due to degradation of the second surface mirrors (optical solar reflectors) that cover the reservoir's radiation

Diagnosis: Unknown **Sure:** 0

Impact: Unknown **Duration** Unknown

Category: Other

Comments: American Test Satellite

References: RSS38

Name: AUSSAT A1

Commercial: ☒ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: Jan 1986 to Jun 1989

Description: Anomalous phantom commands that changed modes in the telemetry system and the attitude control system. 19 such events occurred

Diagnosis: ESD **Sure:** 0

Impact: Unknown **Duration:** Unknown

Category: Phantom commands

Comments: Australian Domestic Telecommunications Satellite

References: RSS7

Name: AUSSAT A2

Commercial: ☒ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: May 1986 to Jun 1990

Description: Anomalous phantom commands that affected the telemetry subcommutator and attitude control system. 33 such events occurred

Diagnosis: ESD **Sure:** 0

Impact: Unknown **Duration:** Unknown

Category: Phantom commands

Comments: Australian Domestic Telecommunications Satellite

References: RSS7

Name: AUSSAT A3

Commercial: ☒ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: Oct 1987 to Oct 1990

Description: Anomalous phantom commands that affected the telemetry subcommutator and attitude control system. 19 such events occurred

Diagnosis: ESD **Sure:** 0

Impact: Unknown **Duration:** Unknown

Category: Phantom commands

Comments: Australian Domestic Telecommunications Satellite

References: RSS7

Name: AUSSAT K1

Commercial: ☒ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: 11 Nov 1985

Description: Bit flip in Encoder Device

Diagnosis: SEU **Sure:** 1

Impact: Loss of telemetry for a few seconds **Duration:** Minimal

Category: Other

Comments: None

References: DCW15, JEM3

Name: Brazilsat A1

Commercial: ☒ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: 13 Aug 89; 19 Oct 89; 29 Sept 89

Description: Degraded solar panel power generation

Diagnosis: Solar Proton Event **Sure:** 2

Impact: Unknown **Duration:** Unknown

Category: Solar Array Degradati

Comments: None

References: DCW16, JEM4

Name: BS 3A

Commercial: ☒ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: 22-31 March 1991

Description: Lost power panel output. One-quarter of solar cells are unavailable

Diagnosis: Solar Proton Event **Sure:** 2

Impact: Forced reduction in the quantity of TV signals carried. Has severe power budget. Unable to continue its three-channel broadcasting from mid-May to mid-August **Duration:** Unknown

Category: Solar Array Degradati

Comments: Plan to reuse old BS 2B satellite for one channel until BS 3H is launched on April 19, 1991. (Japanese TV Satellite)

References: HCK33, JHA2

Name: BS 3A (Japanese Broadcasting satellite)
Commercial: ☒ **NASA/NOAA:** ☐ **Scientific:** ☐
DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒
Dates: 22 Feb 1994
Description: 60-minute telemetry outage
Diagnosis: ESD **Sure:** 0
Impact: 60-minute telemetry outage **Duration** 10 min to 1 hr
Category: Degraded Performanc
Comments: None
References: RSS2, RSS5, RSS6

Name: CRRES
Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☒
DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐
Dates: 30 March 1991
Description: DTU #1 failed during support. Switched to DTU #2 at next contact
Diagnosis: ESD Internal **Sure:** 2
Impact: Loss of data until next contact (~2.5 hours) **Duration** 1 hr to 1 day
Category: System Failure
Comments: Period of high relativistic electron fluxes following large March 1991 magnetic storm
References: HCK22

Name: CRRES

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☒

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 17 May 1991

Description: Telemetry lost. Reselecting and power cycling DTU #2 did not restore telemetry. Switched back to DTU #1 and telemetry was restored

Diagnosis: ESD Internal **Sure:** 2

Impact: 8000 seconds of data lost **Duration** 1 hr to 1 day

Category: System Failure

Comments: Reference contains interesting copies of Initial Anomaly Reports

References: HCK21

Name: CRRES

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☒

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 4 May 1991

Description: Telemetry lost. DTU #2 was reselected. This restored telemetry

Diagnosis: Unknown **Sure:** 0

Impact: Temporary loss of data **Duration** Unknown

Category: Degraded Performanc

Comments: None

References: HCK21

Name: CRRES

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☒

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 7 April 1991

Description: AFGL 701-8 was found misconfigured one time

Diagnosis: ESD Internal **Sure:** 2

Impact: Loss of data until next contact (contacts were ~11 hours apart) **Duration** 1 hr to 1 day

Category: Phantom commands

Comments: Period of high relativistic electron fluxes following large March 1991 magnetic storm

References: HCK22

Name: CRRES

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☒

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 4 April 1991

Description: AFGL 701-11A High Voltage Power Supply was found at the wrong level

Diagnosis: ESD Internal **Sure:** 2

Impact: Loss of data until next contact (contacts were ~11 hours apart) **Duration** 1 hr to 1 day

Category: Phantom commands

Comments: Period of high relativistic electron fluxes following large March 1991 magnetic storm

References: HCK22

Name: CRRES

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☒

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 3 April 1991

Description: AFGL 701-6 was found in wrong mode (Mode 0) one time

Diagnosis: ESD Internal **Sure:** 2

Impact: Loss of data until next contact (contacts were ~11 hours apart) **Duration** 1 hr to 1 day

Category: Phantom commands

Comments: Period of high relativistic electron fluxes following large March 1991 magnetic storm

References: HCK22

Name: CRRES

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☒

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 31 March 1991

Description: CMOS time off by 15 seconds

Diagnosis: ESD Internal **Sure:** 2

Impact: Loss of data until next contact (contacts were ~11 hours apart) **Duration** 1 hr to 1 day

Category: Degraded Performance

Comments: Period of high relativistic electron fluxes following large March 1991 magnetic storm

References: HCK22

Name: CRRES

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☒

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 30 March 1991

Description: PCU status BAD. Sent processor reset and V/T = 6

Diagnosis: ESD Internal **Sure:** 2

Impact: Loss of data until next contact (contacts were ~11 hours apart) **Duration** 1 hr to 1 day

Category: Phantom commands

Comments: Period of high relativistic electron fluxes following large March 1991 magnetic storm

References: HCK22

Name: CRRES

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☒

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 26 March to 10 April 1991

Description: AFGL 701-2 found in wrong mode (CAL MODE) three times

Diagnosis: ESD Internal **Sure:** 2

Impact: Loss of data until next contact (contacts were ~11 hours apart) **Duration** 1 hr to 1 day

Category: Phantom commands

Comments: Period of high relativistic electron fluxes following large March 1991 magnetic storm

References: HCK22

Name: CRRES

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☒

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 26 March to 10 April 1991

Description: PCU Status was bad three times

Diagnosis: ESD Internal **Sure:** 2

Impact: Loss of data until next contact (contacts were ~11 hours apart) **Duration** 1 hr to 1 day

Category: Phantom commands

Comments: Period of high relativistic electron fluxes following large March 1991 magnetic storm

References: HCK22

Name: CRRES

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☒

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 26 March to 10 April 1991

Description: ONR 307-3 found in improper mode (Load Mode) 21 times

Diagnosis: ESD Internal **Sure:** 2

Impact: Loss of data until next contact (contacts were ~11 hours apart) **Duration** 1 hr to 1 day

Category: Phantom commands

Comments: Period of high relativistic electron fluxes following large March 1991 magnetic storm

References: HCK22

Name: CRRES

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☒

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 26 March to 10 April 1991

Description: AFGL 701-15 was found misconfigured two times

Diagnosis: ESD Internal **Sure:** 2

Impact: Loss of data until next contact (contacts were ~11 hours apart) **Duration** 1 hr to 1 day

Category: Phantom commands

Comments: Period of high relativistic electron fluxes following large March 1991 magnetic storm

References: HCK22

Name: CRRES

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☒

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 26 March to 10 April 1991

Description: AFGL 701-14 found misconfigured 17 times

Diagnosis: ESD Internal **Sure:** 2

Impact: Loss of data each time until next contact (contacts were ~11 hours apart) **Duration** 1 hr to 1 day

Category: Phantom commands

Comments: Period of high relativistic electron fluxes following large March 1991 magnetic storm

References: HCK22

Name: CRRES

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☒

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 26 March to 10 April 1991

Description: AFGL 701-2 was off three times

Diagnosis: ESD Internal **Sure:** 2

Impact: Loss of data until next contact (contacts were ~11 hours apart) **Duration:** 1 hr to 1 day

Category: Phantom commands

Comments: Period of high relativistic electron fluxes following large March 1991 magnetic storm

References: HCK22

Name: CRRES

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☒

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: Jul 1990 TO Mar 1991

Description: Bit flips

Diagnosis: SEU **Sure:** 3

Impact: Unknown **Duration:** Unknown

Category: Other

Comments: Observed in each orbit with the 93422 and 931422 bipolar random access memories (RAM) being the most sensitive

References: RSS46

Name: CRRES

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☒

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 30 March 1991

Description: Tape Recorder #2 status unknown and readout commands nonfunctional

Diagnosis: ESD Internal **Sure:** 2

Impact: ?? Loss of T/R 2 ?? **Duration** Unknown

Category: System Failure

Comments: Period of high relativistic electron fluxes following large March 1991 magnetic storm

References: HCK22

Name: CS 3B

Commercial: ☒ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: 17 Mar 1989

Description: Command Circuitry failed

Diagnosis: ESD Internal **Sure:** 0

Impact: Permanent lost of 1/2 of command circuitry on board **Duration** Unknown

Category: System Failure

Comments: None

References: JHA13, JHA15

Name: CTS

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☒

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: After Nov 1977

Description: A transient event counter recorded 215 transient events in the wiring harnesses in the first year. A power diode failed causing a power bus burnout

Diagnosis: ESD **Sure:** 3

Impact: Unknown **Duration:** More than 1 wk

Category: System Failure

Comments: (Hermes, Canadian-American Communications Technology Satellite)

References: RSS26, RSS27

Name: DE 1

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☒

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: After Aug 1981

Description: Unexplained 7 to 10 watt power increase on the spacecraft bus and apparent loss of microprocessor in the command and telemetry processor

Diagnosis: SEU **Sure:** 0

Impact: Unknown **Duration:** Unknown

Category: System Failure

Comments: Radiation 'hits' impinging on the spacecraft clock, etc. (Dynamics Explorer)

References: RSS38

Name: DE 1

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☒

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 1982

Description: Failure of high voltage power supply on the High Altitude Plasma Indicator (HAPI)

Diagnosis: SEU **Sure:** 0

Impact: Spacecraft was operating in degraded mode **Duration:** Unknown

Category: System Failure

Comments: (Dynamics Explorer)

References: RSS56

Name: DFS 3

Commercial: ☒ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: Nov 95

Description: Suffered a complete breakdown and started drifting uncontrollably

Diagnosis: Unknown **Sure:** 0

Impact: Mission Loss. Declared a total loss and conveyed to a graveyard orbit **Duration:** Mission loss

Category: Mission Loss

Comments: Deutsche Telekom

References: JHA 18

Name: DMSP
Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐
DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐
Dates: Mar 89
Description: Had trouble unloading torque due to the large ambient magnetic field changes in orbit
Diagnosis: Magnetic Field Variability **Sure:** 0
Impact: Unknown **Duration** 1 hr to 1 day
Category: Other
Comments: Great magnetic storm
References: JHA 15

Name: DMSP
Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐
DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐
Dates: 24 Jul 97
Description: Passive microwave sensor failure
Diagnosis: ESD Internal **Sure:** 0
Impact: Unknown **Duration** More than 1 wk
Category: System Failure
Comments: None
References: SWS1

Name: DMSP F-13

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 5 May 1995

Description: Latch-up of microwave imaging instrument (SSM/I) microprocessor. Required reset of instrument

Diagnosis: ESD Surface **Sure:** 3

Impact: Loss of data until spacecraft recommended **Duration** 1 hr to 1 day

Category: Degraded Performanc

Comments: Diagnosed from SSJ/4 particle detector and RPA plasma measurements. Occurred in an intense auroral arc

References: PCA2

Name: DMSP F1

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 9 Aug 1979

Description: OLS reset while using backup encoder pulses

Diagnosis: SEU-Solar Proton Event **Sure:** 3

Impact: Loss of data until recommended **Duration** 1 hr to 1 day

Category: Phantom commands

Comments: Reset due to processor upset by proton event

References: PCA1

Name: DMSP F10

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 19 Apr 93

Description: Channel loss on the high gain analog amplifier.

Diagnosis: ESD Surface **Sure:** 2

Impact: Unknown **Duration:** More than 1 wk

Category: System Failure

Comments: Increase in precipitating electron fluxes as the satellite traversed the auroral zone

References: SWS1

Name: DMSP F2

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 1977

Description: SSIE data degraded due to inaccurate calibration. Caused by static buildup on spacecraft

Diagnosis: Surface Charging **Sure:** 2

Impact: Severe degradation of sensor data **Duration:** More than 1 wk

Category: Degraded Performanc

Comments: Fixed on F4 by isolating ion probe from ground

References: PCA1

Name: DMSP F2

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 29 June 1977

Description: Celestial sensor (CSA) experienced false transits

Diagnosis: SEU **Sure:** 3

Impact: Loss of pointing accuracy. Important for imaging sensors. Honeywell designed CSA mod for F5 **Duration** Unknown

Category: Phantom commands

Comments: Proton hits outside South Atlantic Anomaly

References: PCA1

Name: DMSP F2

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 22 Sept 1977

Description: Primary attitude sensor reset several times in South Atlantic Anomaly

Diagnosis: SEU-South Atlantic Anomaly **Sure:** 3

Impact: Loss of pointing accuracy. Important for imaging sensors **Duration** Unknown

Category: Degraded Performanc

Comments: Incorporated software change to star fix

References: PCA1

Name: DMSP F2

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 22 Dec 1978

Description: Spacecraft rose with main memory off and recorders and data transmitters not operating per the stored commands

Diagnosis: SEU **Sure:** 1

Impact: Loss of data until recommended **Duration** 1 hr to 1 day

Category: Phantom commands

Comments: Probably due to proton stimulated processor error

References: PCA1

Name: DMSP F2

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 31 May 1978

Description: Long OLS (Operational Linescan System) auto restart. Approx 2 min compared to normal 15 to 40 sec

Diagnosis: SEU **Sure:** 1

Impact: Minimal **Duration** Less than 10 min

Category: Other

Comments: May be due to unusual pattern of proton effects. No indication of system failure

References: PCA1

Name: DMSP F3

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 17 Sept 1979

Description: OLS soft reset

Diagnosis: SEU **Sure:** 3

Impact: Minimal **Duration** Unknown

Category: Other

Comments: None

References: PCA1

Name: DMSP F3

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 17 Sept 1979

Description: OLS reset, tape recorder PR3 turned off without command

Diagnosis: SEU **Sure:** 3

Impact: Loss of data until recommended **Duration** 1 hr to 1 day

Category: Phantom commands

Comments: None

References: PCA1

Name: DMSP F6

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 12 Oct 1983

Description: Spacecraft switched from PRADS to basic attitude mode

Diagnosis: SEU **Sure:** 2

Impact: Loss of pointing accuracy. Important for imaging sensors **Duration** 1 hr to 1 day

Category: Phantom commands

Comments: Proton activity

References: PCA1

Name: DMSP F6

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 7 Feb 1983

Description: OLS reset

Diagnosis: SEU-South Atlantic Anomaly **Sure:** 3

Impact: Data lost until spacecraft recomanded **Duration** 1 hr to 1 day

Category: Phantom commands

Comments: Consistently occurs in South Atlantic Anomaly

References: PCA1

Name: DMSP F6

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 7 Feb 1983

Description: OLS reset

Diagnosis: SEU-South Atlantic Anomaly **Sure:** 3

Impact: Data lost until spacecraft recommended **Duration** 1 hr to 1 day

Category: Degraded Performanc

Comments: Consistently occurs in South Atlantic Anomaly

References: PCA1

Name: DMSP F6

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 27 Dec 1982

Description: Celestial sensor (CSA) producing false star transits

Diagnosis: SEU **Sure:** 3

Impact: Reduced pointing accuracy . Important for imaging sensors **Duration** Unknown

Category: Degraded Performanc

Comments: CSA modified after similar anomalies on F2 and F3. Starfix module was enabled. Proton Activity

References: PCA1

Name: DMSP FLT 13

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 14 Aug 96

Description: Sensor package went off-line

Diagnosis: SEU **Sure:** 2

Impact: Unknown **Duration** Unknown

Category: Phantom commands

Comments: None

References: SWS1

Name: DMSP FLT 13

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 02 Dec 96

Description: Gyro fluctuations and erratic spinning of the SSMI microwave imager resulting in the SSMI going off line

Diagnosis: ESD Surface **Sure:** 1

Impact: Unknown **Duration** Unknown

Category: Degraded Performanc

Comments: None

References: SWS1

Name: DMSP FLT 8

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 15 Feb 94

Description: Microprocessor lock-up on the microwave imaging system

Diagnosis: ESD Internal **Sure:** 2

Impact: Unknown **Duration:** 1 hr to 1 day

Category: Degraded Performanc

Comments: Very large increase in 10-30 KeV electrons may have resulted in this anomaly

References: SWS1

Name: DRA Delta

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: June 1994 to 1995

Description: 120 identical status switching anomalies; phantom commands disable logic in the Attitude Measurement Equipment

Diagnosis: ESD Internal **Sure:** 3

Impact: Little operational impact **Duration:** Minimal

Category: Phantom commands

Comments: GEO s/ c of Defense Research Aging, Farnborough, England

References: JEM5

Name: DSCC III FLT (B-10)

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 14 Mar 94

Description: Upset of attitude control system

Diagnosis: ESD Internal **Sure:** 2

Impact: Unknown **Duration:** Unknown

Category: Other

Comments: Significantly enhanced energetic electron fluxes

References: SWS1

Name: DSCS A2

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 23-25 September 1991

Description: CPU Failure

Diagnosis: Unknown **Sure:** 0

Impact: Unknown **Duration:** More than 1 wk

Category: System Failure

Comments: None

References: RSS7

Name: DSCS II

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 14 Sep 95

Description: Command Path-Electric Interface Assembly
length checks and address check areas

Diagnosis: ESD Internal **Sure:** 3

Impact: None **Duration** Unknown

Category: Other

Comments: >2 MeV electrons enhanced

References: SWS1

Name: DSCS II

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 08 Apr 95

Description: Anomalous NUDET detection

Diagnosis: ESD Internal **Sure:** 1

Impact: Unknown **Duration** Unknown

Category: Spurious Signal

Comments: Significant >2 MeV electron enhancements

References: SWS1

Name: DSCS II (9431)

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 2 June 1973

Description: Satellite failed because power to its communications subsystem was suddenly interrupted

Diagnosis: ESD Surface **Sure:** 3

Impact: Mission Loss. Initiated joint NASA and Air Force spacecraft charging investigation. High energy discharge caused by spacecraft charging as a result of a geomagnetic substorm **Duration** Mission loss

Category: Mission Loss

Comments: None

References: RSS31,RSS32

Name: DSCS II (9438)

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: Nov and Dec 1986

Description: Low level logic glitches

Diagnosis: ESD Internal **Sure:** 0

Impact: Unknown **Duration** Unknown

Category: Other

Comments: None

References: RSS7

Name: DSCS II (9442)

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: Nov 1986 and Mar 1987

Description: Low level logic glitches

Diagnosis: ESD Internal **Sure:** 0

Impact: Unknown **Duration:** Unknown

Category: Other

Comments: None

References: RSS7

Name: DSCS II (9443)

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: Mar and Jul 1987

Description: Low level logic glitches

Diagnosis: ESD Internal **Sure:** 0

Impact: Unknown **Duration:** Unknown

Category: Other

Comments: None

References: RSS7

Name: DSCS II B7

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 26 March 1996

Description: Attitude Control Electronics failed

Diagnosis: ESD Surface **Sure:** 0

Impact: Unknown **Duration:** More than 1 wk

Category: System Failure

Comments: Suggestive evidence that the anomaly could have been caused by surface charging. The surface of the vehicle as measured by an onboard sensor was charged to about 3 kV at the time of the anomaly

References: HCK3

Name: DSCS III

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 22 June 1994, 6 July 1994, 16 Oct 1994, 24

Description: NUDET event processing caused patch to disable

Diagnosis: ESD Internal **Sure:** 3

Impact: 10/16/94 caused RAM patch to be disabled. RAM patch had to be restored. 10/24/94 EYC disabled. Support scheduled to execute 'EYC not -enabled' contingency **Duration:** More than 1 wk

Category: Degraded Performanc

Comments: Possible attitude loss of yaw control due to NUDET event processing

References: HCK5, HCK6

Name: DSCS III

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 10 Nov 95

Description: Software detected fault in the logic circuit caused shutdown of the RAM-PATCH module

Diagnosis: ESD Internal **Sure:** 3

Impact: Unknown **Duration:** Unknown

Category: Degraded Performanc

Comments: >2 MeV electrons significantly enhanced

References: SWS1

Name: DSCS III

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 09 Nov 95

Description: CPU cycle time over

Diagnosis: ESD Internal **Sure:** 1

Impact: Unknown **Duration:** Unknown

Category: Other

Comments: >2 MeV electrons elevated

References: SWS1

Name: DSCS III (4524)
Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐
DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐
Dates: Dec 1986 to Jan 1987
Description: Glitches in the tachometer system (10)
Diagnosis: ESD Internal **Sure:** 0
Impact: Unknown **Duration** Unknown
Category: Other
Comments: None
References: RSS7

Name: DSCS III (4524)
Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐
DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐
Dates: several from 16 Dec 1986 to 16 May 1987
Description: Tachometer problem
Diagnosis: Unknown **Sure:** 0
Impact: Unknown **Duration** Unknown
Category: Other
Comments: None
References: RSS7

Name: DSCS III B-7

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 26 Mar 96

Description: CPU error and altitude control excursion

Diagnosis: ESD Internal **Sure:** 3

Impact: Unknown **Duration** Unknown

Category: Degraded Performanc

Comments: None

References: SWS1

Name: DSCS III B-9

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 24 mar 96 & 25 Mar 96

Description: Telemetry problems

Diagnosis: ESD Internal **Sure:** 1

Impact: Unknown **Duration** Unknown

Category: Degraded Performanc

Comments: Other satellites in close proximity
experienced no injections, B-9 has been
exposed to greater injections in the past with
no problems experienced

References: SWS1

Name: DSCS III B4 & B9

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 30 Mar 1994, 15 May 1994, 11 Sept 1994, 3

Description: KI-31 autonomously switched from using the satellites master clock to its own internal oscillator

Diagnosis: SEU **Sure:** 0

Impact: Command access to vehicle lost on 9/11/94 until the KI-31 was commanded back(?!). On 10/3/94 had to use ACE mitigation plan to switch back to frequency standard **Duration** 1 hr to 1 day

Category: Phantom commands

Comments: Probably no user impact

References: HCK4

Name: DSCS III FLT 17

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 03 Oct 94

Description: K1-31 switch from the master clock to the internal oscillator

Diagnosis: ESD **Sure:** 2

Impact: Unknown **Duration** Unknown

Category: Phantom commands

Comments: Significantly enhanced geomagnetic and energetic particle environment

References: SWS1

Name: DSCS III FLT 21

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 08 Oct 96

Description: RAM patch disable

Diagnosis: ESD **Sure:** 3

Impact: Unknown **Duration** Unknown

Category: Degraded Performanc

Comments: None

References: SWS1

Name: DSCS III FLT 23

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 24 Oct 94

Description: Enhanced Yaw Control Patch to Disable

Diagnosis: Unknown **Sure:** 0

Impact: Unknown **Duration** Unknown

Category: Degraded Performanc

Comments: Spacecraft charging or SEU

References: SWS1

Name: DSCS III FLT 23

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 24 Oct 94

Description: Enhanced Yaw Control Patch disabled (due to NUDET event processing)

Diagnosis: ESD **Sure:** 0

Impact: Unknown **Duration:** Unknown

Category: Degraded Performanc

Comments: Significantly disturbed geomagnetic and energetic particle environment

References: SWS1

Name: DSCS III FLT 23

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 11 May 95

Description: Uncommanded internal oscillator swap

Diagnosis: ESD Internal **Sure:** 1

Impact: Unknown **Duration:** Unknown

Category: Phantom commands

Comments: None

References: SWS1

Name: DSCS-III FLT 21

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 01 Oct 97

Description: Anomalous Nuclear Event Detector Trip

Diagnosis: ESD Internal **Sure:** 3

Impact: Unknown **Duration** Unknown

Category: Spurious Signal

Comments: Enhanced energetic particle environment. >2 MeV

References: SWS1

Name: DSP F?

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: ?

Description: Sensor Temp Monitor Shift in Calibration

Diagnosis: ESD Surface **Sure:** 1

Impact: None **Duration** Unknown

Category: Degraded Performanc

Comments: Anomalies correlate with occurrence of focal plane strobes which are thought to be caused by charging

References: JLR18

Name: DSP F1

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 1 July 1971

Description: False trigger signals in MIIIB Control Counter Monitor

Diagnosis: ESD Surface **Sure:** 2

Impact: Only annoyance to spacecraft controllers **Duration** Unknown

Category: Spurious Signal

Comments: Correlation of many events with Ap index and local time occurrence in 2300-0600 sector

References: JLR1

Name: DSP F10

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: June 15, 1983

Description: Uncommanded Mode Switch

Diagnosis: ESD Surface **Sure:** 2

Impact: None **Duration** Unknown

Category: Degraded Performanc

Comments: Onboard detectors saturated. Suggestive correlation of anomaly with electron data from other DSP satellites

References: JLR17

Name: DSP F2

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 18 & 20 May 1971

Description: Digital Telemetry Unit subcom B calibration change (partial short)

Diagnosis: ESD Surface **Sure:** 0

Impact: Only annoyance to spacecraft controllers.
Re-interpretation of housekeeping channels **Duration** More than 1 wk

Category: Degraded Performanc

Comments: No engineering reason for short, so it must be the environment

References: JLR2

Name: DSP F2

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: Various

Description: Noise Strobes over Focal Plane

Diagnosis: ESD Surface **Sure:** 1

Impact: Bad data removed by ground processing **Duration** 1 hr to 1 day

Category: Spurious Signal

Comments: Local time distribution centers at midnight to dawn sector

References: JLR3

Name: DSP F2

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: February 13-14, 1978

Description: Excessive Star Sensor Output

Diagnosis: Solar Proton Event **Sure:** 3

Impact: Intermittent loss of data totaling 900 s **Duration** 10 min to 1 hr

Category: Spurious Signal

Comments: Must use backup attitude processing algorithms instead of primary method

References: JLR4

Name: DSP F3

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: March 3, 1974

Description: Mission IIIB Sensor Degradation

Diagnosis: Total Radiation Dose **Sure:** 0

Impact: Loss of redundant sensor (one of three) **Duration** More than 1 wk

Category: Random Part Failure

Comments: No coincident particle data but similar degradation observed during May and August 1972 particle events

References: JLR5

Name: DSP F3

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: Various

Description: Noise Strobes over Focal Plane

Diagnosis: ESD Surface **Sure:** 1

Impact: Bad data removed by ground processing **Duration** 1 hr to 1 day

Category: Spurious Signal

Comments: Local time distribution centers at midnight to dawn sector

References: JLR3

Name: DSP F4

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: Various

Description: Noise Strobes over Focal Plane

Diagnosis: ESD Surface **Sure:** 1

Impact: Bad data removed by ground processing **Duration** Unknown

Category: Spurious Signal

Comments: Local time distribution centers at midnight to dawn sector

References: JLR3

Name: DSP F4

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: July 6, 1973 0840 UT

Description: Focal Plane Heater Inadvertent Inhibit

Diagnosis: ESD Surface **Sure:** 1

Impact: Annoyance to ground controller **Duration:** Unknown

Category: Phantom commands

Comments: Poor correlation with Kp and ground magnetograms

References: JLR6

Name: DSP F4

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: June 4, 1974 0107 UT

Description: Star Sensor Threshold Level Uncommanded Change

Diagnosis: ESD Surface **Sure:** 1

Impact: None **Duration:** Unknown

Category: Phantom commands

Comments: No supporting particle data. Anomaly correlated with focal plane strobes thought to be caused by charging

References: JLR7

Name: DSP F4

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: July 3, 1973 0125 UT

Description: SRI QCM Inadvertently Turned Off

Diagnosis: ESD Surface **Sure:** 0

Impact: None **Duration:** Unknown

Category: Phantom commands

Comments: Local time occurrence of event in midnight sector

References: JLR8

Name: DSP F6

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: January 30, 1977

Description: IR Noise Bursts

Diagnosis: ESD Surface **Sure:** 1

Impact: Removed from data by ground processing **Duration:** Unknown

Category: Spurious Signal

Comments: Local time distribution is midnight to dawn sector

References: JLR9

Name: DSP F6

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: March 28 , 1983

Description: Earth Sensor Assembly A Failure

Diagnosis: ESD Surface **Sure:** 1

Impact: Loss of Earth lock and data for 24 h. Loss of subsystem redundancy **Duration** 1 hr to 1 day

Category: System Failure

Comments: Coincident with end of eclipse interval.
Weak correlation with electron data from other satellites

References: JLR10

Name: DSP F6

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: Jan 8, 1985 1730-2030 UT

Description: Earth Sensor Assembly B Failure

Diagnosis: ESD Surface **Sure:** 1

Impact: Loss of attitude subsystem redundancy **Duration** More than 1 wk

Category: System Failure

Comments: Anomaly time uncertain within 3 hours. Two substorm electron injections during this interval from measurements on other satellites

References: JLR11

Name: DSP F6

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: February 13-14, 1978

Description: Excessive Star Sensor Output

Diagnosis: Solar Proton Event **Sure:** 3

Impact: Intermittent loss of data totaling 900 s **Duration** 10 min to 1 hr

Category: Spurious Signal

Comments: Must use backup attitude processing algorithms instead of primary method

References: JLR4

Name: DSP F7

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: Jan 24, 1985

Description: Earth Sensor Assembly B Failure

Diagnosis: ESD Surface **Sure:** 0

Impact: Software changes required to continue mission **Duration** More than 1 wk

Category: System Failure

Comments: No supporting particle data but "similar" to previous Anomaly 1097 which was suspected as surface charging

References: JLR12

Name: DSP F7

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: Dec 3, 1983

Description: Link 2 Quality Alarms, Intermittent Signal Strength

Diagnosis: ESD Surface **Sure:** 1

Impact: Degraded data quality for several hours **Duration** 1 hr to 1 day

Category: Degraded Performanc

Comments: Correlation between alarms and electron flux from onboard detector not very consistent

References: JLR14

Name: DSP F7

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: February 13-14, 1978

Description: Excessive Star Sensor Output

Diagnosis: Solar Proton Event **Sure:** 3

Impact: Intermittent loss of data totaling 900 s **Duration** 10 min to 1 hr

Category: Spurious Signal

Comments: Must use backup attitude processing algorithms instead of primary method

References: JLR4

Name: DSP F7

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: Nov 9-10, 1983

Description: Earth Sensor Assembly A Failure

Diagnosis: ESD Surface **Sure:** 3

Impact: Loss of Earth lock and data for 1800 s **Duration** 10 min to 1 hr

Category: System Failure

Comments: Correlation of two events with peaks in electron flux from onboard detector good within several minutes

References: JLR13

Name: DSP F9

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: Feb 10 , 1983 1200 UT

Description: Crypto Power Supply KPP-29A-A
Anomalous Turn-on and Failure

Diagnosis: ESD Surface **Sure:** 3

Impact: Loss of command subsystem redundancy **Duration** More than 1 wk

Category: System Failure

Comments: Strong correlation of two anomaly events with electron flux peak from on-board detector

References: JLR15

Name: DSP F9

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: October 7, 1982

Description: Crypto Power Supply KPP-29A-B Failure

Diagnosis: ESD Surface **Sure:** 3

Impact: Loss of command subsystem redundancy **Duration** More than 1 wk

Category: System Failure

Comments: Strong correlation of failure with electron flux peak from on-board detector

References: JLR16

Name: DSP PAR 4

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 14 Sep 95

Description: Current spike on primary bus current

Diagnosis: ESD Internal **Sure:** 1

Impact: Unknown **Duration** Unknown

Category: Spurious Signal

Comments: Injection 51-107 KeV and 107-315 KeV electrons

References: SWS1

Name: ERBS

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☒

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 1 Nov 1984

Description: Bit changes in block (delta time) section of both command memories. There were 142 'hits' recorded to date

Diagnosis: SEU **Sure:** 1

Impact: Unknown **Duration** Unknown

Category: Degraded Performanc

Comments: Earth Radiation Budget Satellite

References: RSS51

Name: ERBS

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☒

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 7 Oct 1993

Description: Anomalous changes in chips located in the Command Storage Memory

Diagnosis: Unknown **Sure:** 0

Impact: CSM-2 unreliable and time tags changed. Stop use of CSM-2 and use only CSM-1 **Duration** More than 1 wk

Category: System Failure

Comments: Noise and radiation. (Earth Radiation budget Satellite)

References: RSS33

Name: ERS-1

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: After Jul 1991

Description: A Precision Range Rate Equipment (PRARE) instrument failed following a transient high current event

Diagnosis: SEU-South Atlantic Anomaly **Sure:** 0

Impact: Unknown **Duration:** More than 1 wk

Category: System Failure

Comments: (European Space Agency Remote Sensing satellite)

References: RSS45

Name: ETS-6 (Japanese Engineering Test Satellite)

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: 11 Jul 1979

Description: Reduced effectiveness of solar panels

Diagnosis: Radiation Damage **Sure:** 3

Impact: Satellite lifetime reduced **Duration:** More than 1 wk

Category: Solar Array Degradati

Comments: Satellite failed to reach geostationary orbit and high Van Allen Belt radiation levels quickly eroded the efficiency of the solar panels

References: RSS42

Name: EUVE

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☒

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: Nov 1993

Description: 'Clam-up' (all detector doors shut). Payload put into pre-launch mode

Diagnosis: SEU **Sure:** 0

Impact: System restored to normal on day of each anomaly with no damage **Duration** 1 hr to 1 day

Category: Phantom commands

Comments: (Extreme Ultraviolet Explorer)

References: RSS33

Name: F2, F3, F4

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☒ **Foreign:** ☐

Dates: 8,9,10 September 1984

Description: Observed in telemetry

Diagnosis: Unknown **Sure:** 0

Impact: Unknown **Duration** Unknown

Category: Other

Comments: Period of unusually high solar and geomagnetic activity

References: HCK19

Name: FLTSATCOM

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 2/11/87, 3/3/87, 5/10/87, 6/12/87, 6/20/87

Description: Low level logic problems

Diagnosis: ESD Internal **Sure:** 0

Impact: Unknown **Duration:** Unknown

Category: Spurious Signal

Comments: None

References: RSS7

Name: FLTSATCOM 6071

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: Mar to Jun 1987

Description: Low level logic anomalies

Diagnosis: ESD Internal **Sure:** 0

Impact: System restored to normal on day of each anomaly with no damage **Duration:** 1 hr to 1 day

Category: Spurious Signal

Comments: Five deep dielectric charging events

References: RSS7

Name: FLTSATCOM-1

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 12 May 95

Description: Relay flip switch

Diagnosis: ESD Internal **Sure:** 1

Impact: Unknown **Duration:** Unknown

Category: Phantom commands

Comments: >2 MeV electrons enhanced for 9 days prior to anomaly

References: SWS1

Name: FY-1

Commercial: ☒ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: 15 Oct 1988

Description: Failure of attitude control system

Diagnosis: ESD **Sure:** 0

Impact: Mission Loss **Duration:** Mission loss

Category: Mission Loss

Comments: Fengyun-1, Chinese experimental weather satellite

References: HCK36, RSS7

Name: GEO spacecraft (13 commercial)

Commercial: ☒ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 29-30 September 1989

Description: SEUs

Diagnosis: SEU-Solar Proton Event **Sure:** 2

Impact: Unknown **Duration:** Unknown

Category: Unknown

Comments: None

References: HCK33

Name: GEO spacecraft (7 commercial)

Commercial: ☒ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 13-14 Mar 89

Description: Problems maintaining operational attitude orientation within specified ranges

Diagnosis: Magnetic Field Variability **Sure:** 0

Impact: Required 177 manual operator interventions to make thruster adjustments in orbit to maintain the required attitude **Duration:** 1 hr to 1 day

Category: Degraded Performanc

Comments: More than is normally required of controllers during a year of routine observations

References: JHA15

Name: GEO spacecraft (commercial)
Commercial: ☒ **NASA/NOAA:** ☐ **Scientific:** ☐
DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐
Dates: 22-31 March 1991
Description: L-band amplifier failed
Diagnosis: Unknown **Sure:** 0
Impact: Unknown **Duration** More than 1 wk
Category: System Failure
Comments: None
References: HCK33

Name: GEO spacecraft (commercial)
Commercial: ☒ **NASA/NOAA:** ☐ **Scientific:** ☐
DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐
Dates: 22-30 May 1991
Description: L-band amplifier loss
Diagnosis: Unknown **Sure:** 0
Impact: Unknown **Duration** More than 1 wk
Category: System Failure
Comments: None
References: JHA20

Name: GEO spacecraft (various commercial)

Commercial: ☒ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 19-29 October 1989

Description: Pitch glitches and SEUs

Diagnosis: SEU-Solar Proton Event **Sure:** 2

Impact: Unknown **Duration** Unknown

Category: Degraded Performanc

Comments: None

References: HCK33

Name: GMS-3

Commercial: ☒ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates:

Description: Severe scintillation

Diagnosis: Ionospheric Scintillations **Sure:** 0

Impact: Data transmissions were lost for 1 hour **Duration** 10 min to 1 hr

Category: Degraded Performanc

Comments: None

References: JHA15 (?)

Name: GMS-3

Commercial: ☒ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: Sept 1984-Jan 1989

Description: phantom commands

Diagnosis: ESD Surface **Sure:** 1

Impact: Unknown **Duration** Unknown

Category: Phantom commands

Comments: None

References: JEM7

Name: GMS-3

Commercial: ☒ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: Dec 1984 to Aug 1985

Description: Multiple anomalous switching events in the accelerometer. Anomalous gain level stepping the Visible Infrared Spin Scan Radiometer

Diagnosis: ESD Internal **Sure:** 2

Impact: Unknown **Duration** Unknown

Category: Phantom commands

Comments: (Japanese Geostationary Meteorological Satellite , Himawari 3)

References: RSS7, DCW4

Name: GMS-4

Commercial: ☒ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: Jan and Jul 1991

Description: The Visible Infrared Spin Scan Radiometer gain setting experienced an anomalous change in state

Diagnosis: ESD **Sure:** 0

Impact: Unknown **Duration:** Unknown

Category: Phantom commands

Comments: (Japanese Meteorological Satellite, Himawari 4)

References: RSS7

Name: GOES -8

Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 18 & 20 Apr 94

Description: Attitude orbital control system experienced uncommanded thruster burns

Diagnosis: ESD Internal **Sure:** 1

Impact: Unknown **Duration:** Unknown

Category: Phantom commands

Comments: Uncommanded thruster burns while in transfer orbit. C.F. Falcon AFB assessment 5/17/94 & attached reference

References: SWS1

Name: GOES-4

Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 29 Mar 1981 to 26 Nov 1982

Description: The mirror used with the visible Spin Scan Radiometer Atmospheric Sounder, the principle (VISSR) instrument on the spacecraft, suffered phantom commands that began a sudden, undesired repositioning. Eventually it failed completely on 11/26/82

Diagnosis: ESD Surface **Sure:** 0

Impact: New commands were issued by controllers on Earth. Finally taken out of service. The ungrounded radiator was redesigned on GOES-5 before its launch **Duration** Mission loss

Category: Mission Loss

Comments: Mission Loss. Led to the development of the spacecraft anomaly database at NOAA. A portion of the VAS second stage radiation cooler was ungrounded and built up potential from the surrounding plasma until it discharged, creating a large electromagnetic pulse (Geostationary Operational Environmental Satellite)

References: RSS20, RSS21

Name: GOES-5
Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐
DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐
Dates: various from 8/20/81 to 4/3/84
Description: Channel 7 gain stepped from 2 to 3 (48 times)
Diagnosis: ESD Surface **Sure:** 3
Impact: Unknown **Duration:** Unknown
Category: Phantom commands
Comments: None
References: RSS7, HCK25

Name: GOES-5
Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐
DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐
Dates: 19-22 March 1990
Description: Power panel output degradation
Diagnosis: Radiation Damage-Solar Proton Event **Sure:** 3
Impact: Unknown **Duration:** More than 1 wk
Category: Solar Array Degradati
Comments: None
References: HCK33

Name: GOES-5

Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 19 Oct 1989

Description: A major solar flare on 19 Oct degraded the solar array by about 0.5 amps

Diagnosis: Radiation Damage-Solar Proton Event **Sure:** 3

Impact: Unknown **Duration** More than 1 wk

Category: Solar Array Degradati

Comments: None

References: RSS49

Name: GOES-5

Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 1989

Description: The Central Telemetry Unit (CTU) experienced 4 SEUs

Diagnosis: SEU-Cosmic Ray **Sure:** 2

Impact: Unknown **Duration** Unknown

Category: Unknown

Comments: None

References: RSS49

Name: GOES-5

Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 1989

Description: The Central Telemetry Unit (CTU) experienced six SEUs which were associated with solar flares

Diagnosis: SEU-Solar Proton Event **Sure:** 2

Impact: Unknown **Duration:** Unknown

Category: Unknown

Comments: None

References: RSS49

Name: GOES-5 & 6

Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 19-29 October 1989

Description: SEUs

Diagnosis: SEU-Solar Proton Event **Sure:** 2

Impact: Unknown **Duration:** Unknown

Category: Unknown

Comments: Unknown

References: HCK33

Name: GOES-6

Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 12-21 August 1989

Description: Power Panel output degradation

Diagnosis: Radiation Damage-Solar Proton Event **Sure:** 3

Impact: Unknown **Duration** More than 1 wk

Category: Solar Array Degradati

Comments: None

References: HCK33

Name: GOES-6

Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 22-30 Mar 91

Description: Power Panel Output Degradation

Diagnosis: Radiation Damage-Solar Proton Event **Sure:** 3

Impact: Equal to 3-year loss **Duration** More than 1 wk

Category: Solar Array Degradati

Comments: None

References: JHA20

Name: GOES-6
Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐
DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐
Dates: 19-22 March 1990
Description: Power panel output degradation
Diagnosis: Radiation Damage-Solar Proton Event **Sure:** 3
Impact: Equivalent to 3 years lost from end of life **Duration** More than 1 wk
Category: Solar Array Degradati
Comments: None
References: HCK33

Name: GOES-6
Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐
DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐
Dates: 9 Mar 1988
Description: The telemetry was permanently degraded
Diagnosis: SEU **Sure:** 0
Impact: Loss of several analog and digital channels **Duration** More than 1 wk
Category: System Failure
Comments: None
References: RSS50

Name: GOES-6

Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 27 Sep 1986, 17 Mar 1986

Description: Uncommanded shift in visible Infrared Spin Scan Radiometer Atmospheric sounder (VAS) Earth window. X-ray scan shifted to calibration mode

Diagnosis: ESD **Sure:** 0

Impact: Unknown **Duration** Unknown

Category: Phantom commands

Comments: None

References: RSS7, RSS15

Name: GOES-6

Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 7 Jul 1984

Description: Loss of pulse code modulated telemetry

Diagnosis: SEU **Sure:** 0

Impact: Unknown **Duration** Unknown

Category: System Failure

Comments: None

References: RSS51

Name: GOES-6

Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 12-21 August 1989

Description: Lost half of telecommunications system

Diagnosis: Unknown **Sure:** 0

Impact: Unknown **Duration:** More than 1 wk

Category: System Failure

Comments: None

References: HCK33, JHA20

Name: GOES-7

Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 26 Feb 1989

Description: The VAS digital multiplexer bit mode command failed after the satellite came out of eclipse

Diagnosis: ESD Surface **Sure:** 1

Impact: Unknown **Duration:** More than 1 wk

Category: Random Part Failure

Comments: This satellite experienced several discharge events in 1987-9 that resulted in phantom commands

References: RSS7, RSS9

Name: GOES-7
Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐
DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐
Dates: 12 Mar 89
Description: Communications Circuit Anomaly
Diagnosis: Unknown **Sure:** 0
Impact: Lost imagery **Duration:** Unknown
Category: System Failure
Comments: None
References: JHA15

Name: GOES-7
Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐
DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐
Dates: 19-30 Oct 89
Description: Solar Array power degradation
Diagnosis: Radiation Damage-Solar Proton Event **Sure:** 3
Impact: 6 year's equivalent lifetime lost **Duration:** More than 1 wk
Category: Solar Array Degradati
Comments: None
References: JHA15

Name: GOES-7

Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 19-22 March 1990

Description: Power panel output degradation

Diagnosis: Radiation Damage-Solar Proton Event **Sure:** 3

Impact: Equal to 3-years loss **Duration** More than 1 wk

Category: Solar Array Degradati

Comments: None

References: HCK33, JHA20

Name: GOES-7

Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 22-24 March 1991

Description: Solar array power degradation

Diagnosis: Radiation Damage-Solar Proton Event **Sure:** 3

Impact: Decrease of 2 to 3 years in expected satellite lifetime **Duration** More than 1 wk

Category: Solar Array Degradati

Comments: None

References: HCK15 RSS61

Name: GOES-7

Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: Jun 1988

Description: The REPLY BUS switch uncommanded from A to B channel in the Central Telemetry Unit (CTU-1)

Diagnosis: SEU **Sure:** 0

Impact: Unknown **Duration:** Unknown

Category: Phantom commands

Comments: None

References: JHA50

Name: GOES-8

Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 19 Apr 1984 and 23 Apr 1994

Description: Sun-presence bit went high and latched ES

Diagnosis: SEU-Radiation Belts **Sure:** 0

Impact: No corrective action required **Duration:** Unknown

Category: Unknown

Comments: None

References: RSS68, JEM6

Name: GOES-8

Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 8-10 Jan 97

Description: Main power supply for the automatic on-board pointing control failed

Diagnosis: ESD Internal **Sure:** 0

Impact: Satellite was out of operation much of the 8th and 9th and was switched back on using the back-up supply on the 10th of January **Duration** 1 day to 1 wk

Category: System Failure

Comments: None

References: JHA10

Name: GOES-8

Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 28 Jun 96

Description: PCEM watchdog timer (WDT) timeout, resulting in a reset of the payload control electronics

Diagnosis: SEU-Cosmic Ray **Sure:** 2

Impact: Unknown **Duration** Unknown

Category: System Failure

Comments: None

References: SWS1

Name: GOES-8

Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 19&21 Apr, 2 Jun, 29 Jul, 9 Aug 1996

Description: Reset of Payload Control Electronics Module

Diagnosis: SEU-Cosmic Ray **Sure:** 3

Impact: Unknown **Duration:** Unknown

Category: Phantom commands

Comments: None

References: SWS1

Name: GOES-8 & 9

Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: ~ 6 Nov 97

Description: Star tracker problems

Diagnosis: Solar Proton Event **Sure:** 2

Impact: Unknown **Duration:** Unknown

Category: Degraded Performanc

Comments: None

References: JHA8

Name: GPS

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 10-16 April 1990

Description: Unknown

Diagnosis: ESD Internal **Sure:** 0

Impact: Unknown **Duration:** Unknown

Category: Other

Comments: 'Experienced problems that may have resulted from enhanced > 2 MeV electron flux'

References: HCK33

Name: GPS (FSV-1)

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 13 June 1980

Description: Solar array wings were misdirected and were not tracking the sun. Tracking Mode changed to HOLD. Three separate logic changes had occurred since previous contact

Diagnosis: ESD Internal **Sure:** 3

Impact: Mistracking occurred for either 44 or 100 minutes before it was determined that the arrays were misdirected. Contingency command plans developed and added to OOH. When the anomaly was discovered all pre-planned activities were aborted and SV data monitored while a course of corrective action was planned **Duration** 1 hr to 1 day

Category: Phantom commands

Comments: Corrective action includes modification to follow-on vehicles. (Did this occur ?)

References: HCK27, HCK28, HCK29

Name: GPS 1

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 2 Sep 78

Description: Frequency shifts in GPS clocks

Diagnosis: ESD Internal **Sure:** 1

Impact: Loss of accuracy of the system until corrected **Duration** 1 day to 1 wk

Category: Degraded Performanc

Comments: While discussed, deep dielectric charging was not specifically identified as the cause. It was put forward by the contractor. Anomalies occurred during rapid rise in dose rate at mission altitude

References: HCK26, JFF4

Name: GPS 2

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 3 Sep 78, 4 Sep 78, 5 Sep 78, 6 Sep 78, 6 Oc

Description: Frequency shifts in GPS clocks

Diagnosis: ESD Internal **Sure:** 1

Impact: Loss of accuracy of the system until corrected **Duration** 1 day to 1 wk

Category: Degraded Performanc

Comments: While discussed, deep dielectric charging was not specifically identified as the cause. It was put forward by the contractor. Anomalies occurred during rapid rise in dose rate at mission altitude

References: HCK26, JFF4

Name: GPS 2

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 8 Oct 78

Description: Clock Failure

Diagnosis: ESD Internal **Sure:** 1

Impact: Unknown **Duration:** More than 1 wk

Category: System Failure

Comments: None

References: HCK26, JFF4

Name: GPS 5118

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 17 JUL 1985

Description: Unexpected switch settings within the motor control electronics

Diagnosis: ESD **Sure:** 0

Impact: Unknown **Duration:** Unknown

Category: Phantom commands

Comments: None

References: RSS6

Name: GPS SVN 26

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 09 OCT 95

Description: Software upset to the Attitude Control Subsystem processor (TI 9989)

Diagnosis: ESD Surface **Sure:** 3

Impact: Unknown **Duration** Unknown

Category: Upset

Comments: Geomagnetic storming and enhanced low energy electrons could have played a role in this anomaly

References: SWS1

Name: GPS SVN-28

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 09 Oct 95

Description: Bit hit to the TI 9789 processor

Diagnosis: ESD Internal **Sure:** 1

Impact: Unknown **Duration** Unknown

Category: Upset

Comments: >2 MeV electrons were above internal charging event levels

References: SWS1

Name: GPS- SVN-11

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 11 Feb 94

Description: PCM-A and PLCM-B malfunctions
resulting in bad telemetry data

Diagnosis: ESD Surface **Sure:** 2

Impact: Unknown **Duration** Unknown

Category: Spurious Signal

Comments: Enhanced levels of 100 KeV electrons

References: SWS1

Name: HEO Spacecraft

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☒ **Foreign:** ☐

Dates: various 1978

Description: Mission data exhibited dropouts

Diagnosis: Plasma Effects-Multipaction **Sure:** 3

Impact: Noise in mission data. Massive effort
troubleshooting the problem. Workarounds
were devised leaving anomaly only a modest
nuisance **Duration** More than 1 wk

Category: Degraded Performanc

Comments: Gamma ray radioactive source could
reproduce the dropouts in laboratory tests

References: JBB1

Name: HEO spacecraft

Commercial: ☐

NASA/NOAA: ☐

Scientific: ☐

DoD: ☐

Classified/Other: ☒

Foreign: ☐

Dates: Unknown

Description: At first turn-on the signal from four preamps were degraded by about 32 dB

Diagnosis: ESD Internal

Sure: 3

Impact: Massive effort to test an engineering model of the subassembly to find a fix for subsequent missions. Redesign of the payload

Duration More than 1 wk

Category: System Failure

Comments: None

References: HCK35

Name: HEO spacecraft (several)

Commercial: ☐

NASA/NOAA: ☐

Scientific: ☐

DoD: ☐

Classified/Other: ☒

Foreign: ☐

Dates: Various

Description: False trips of limit switch

Diagnosis: ESD Surface

Sure: 3

Impact: Significant effort spent troubleshooting. 'Band-aid' attempts were made to harden subsequent missions without much success. Anomaly ultimately became a minor annoyance

Duration Unknown

Category: Phantom commands

Comments: None

References: JBB1

Name: HEO Spacecraft F3

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☒ **Foreign:** ☐

Dates: July and September 1982

Description: RS Uncommanded Mode Changes

Diagnosis: ESD Internal **Sure:** 3

Impact: No Significant Impact **Duration** Unknown

Category: Phantom commands

Comments: None

References: JBB1

Name: HEO Spacecraft F4

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☒ **Foreign:** ☐

Dates: July and September 1982

Description: RS Uncommanded Mode Changes

Diagnosis: ESD Internal **Sure:** 3

Impact: No significant impact **Duration** Unknown

Category: Phantom commands

Comments: None

References: JBB1

Name: Hipparcos

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☒

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 15 Aug 1993

Description: Communication with the satellite was lost

Diagnosis: Total Radiation Dose **Sure:** 0

Impact: Mission Loss. Attempts to restart operations were unsuccessful and mission operations were terminated 4 years and 1 week after launch **Duration** Mission loss

Category: Mission Loss

Comments: ESA astronomy satellite

References: RSS48

Name: HST

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☒

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 11 Apr 1994

Description: SAP test failed during SADE 1 slew, S/C into SAFE MODE

Diagnosis: SEU **Sure:** 0

Impact: Recovered from SAFE MODE **Duration** 1 hr to 1 day

Category: Upset

Comments: None

References: RSS68

Name: HST (STS-31)

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☒

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 9 Dec 1993

Description: The Data Interface Unit-2 (DIU -2), A Side, presented faulty telemetry readings for specific HST parameters

Diagnosis: Radiation Damage **Sure:** 0

Impact: Negligible effect. DIU-2 switched to redundant B-side permanently and problem cleared **Duration** Minimal

Category: Spurious Signal

Comments: None

References: RSS33

Name: HST (STS-31)

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☒

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 4 Jul 1991

Description: Six of the telescopes status monitors failed. Guide star acquisition failures

Diagnosis: Radiation Damage-South Atlantic Anomaly **Sure:** 0

Impact: Unknown **Duration** More than 1 wk

Category: Random Part Failure

Comments: None

References: RSS44

Name: HST (STS-31)

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☒

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 7 May 1990 , 20 Jun 1990

Description: Bit flips occurred in the RAM of Fine Guidance Electronics. High photomultiplier tube (PMT) counts in the fine guidance system

Diagnosis: SEU-South Atlantic Anomaly **Sure:** 3

Impact: Could not operate in South Atlantic Anomaly **Duration:** Less than 10 min

Category: Upset

Comments: None

References: RSS47, JHA Private Communication

Name: HST (STS-31)

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☒

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: Apr 1990

Description: British Aerospace inspection of the old HST array found effects ranging from slight grazing to the puncture of cells and blankets

Diagnosis: Impact-Micrometeoroid **Sure:** 3

Impact: No degradation in the electrical performance from the tests made before launch **Duration:** Minimal

Category: Other

Comments: 5000 to 6000 micrometeoroid impacts during four year life

References: RSS35

Name: INSAT -1

Commercial: ☒ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 13 Sep 1987 to 26 Apr 1988

Description: 6 bit flip errors

Diagnosis: SEU-Cosmic Ray **Sure:** 0

Impact: Unknown **Duration** Unknown

Category: Upset

Comments: None

References: RSS55

Name: INSAT -1B

Commercial: ☒ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 18 Mar-18 Apr 84

Description: Temperature Sensor Anomalies. Damaged FETs in telemetry thermal channels input circuits

Diagnosis: ESD **Sure:** 1

Impact: Unknown **Duration** More than 1 wk

Category: Degraded Performanc

Comments: None

References: DCW3

Name: INSAT -2D

Commercial: ☒ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 1 Oct 97

Description: Failed. Lost connection between power panels and batteries

Diagnosis: ESD Surface **Sure:** 1

Impact: Mission Loss. Shutdown the Indian stock exchange. Shut down communications between the central government and the provinces **Duration** Mission loss

Category: Mission Loss

Comments: Major magnetic storm

References: JHA6, JHA7

Name: INSAT -2D

Commercial: ☒ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: Mar 96

Description: 10 ESD Events

Diagnosis: ESD **Sure:** 0

Impact: Unknown **Duration** Unknown

Category: Unknown

Comments: None

References: JHA 16

Name: Intelsat 510 (International Telecommunicatio
Commercial: ☒ **NASA/NOAA:** ☐
DoD: ☐ **Classified/Other:** ☐
Dates: 15 Jan 1988
Description: Affected the attitude control system and
caused uncommanded status changes
Diagnosis: ESD
Impact: Unknown
Category: Phantom commands
Comments: None
References: RSS7

Scientific: ☐
Foreign: ☒

Sure: 0
Duration Unknown

Name: Intelsat 511
Commercial: ☒ **NASA/NOAA:** ☐
DoD: ☐ **Classified/Other:** ☐
Dates: 25 Sep 86
Description: A status bit change caused the thruster to
switch 'ON' and stay in that setting for 3 to 4
minutes. A normal 'blast' is only 200 ms
Diagnosis: Unknown
Impact: Unknown
Category: Phantom commands
Comments: The emergency thruster gas cut off worked
after about 1 min. to stop the flow and limit
the problem caused by this event
References: JHA11

Scientific: ☐
Foreign: ☒

Sure: 0
Duration Less than 10 min

Name: Intelsat 511

Commercial: ☒ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: August 1993

Description: Disrupted attitude control system caused uncommanded status changes

Diagnosis: ESD **Sure:** 0

Impact: Unknown **Duration:** Unknown

Category: Phantom commands

Comments: None

References: RSS7

Name: Intelsat 511

Commercial: ☒ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: 7 Oct 1995

Description: Thruster firing necessitated safe hold

Diagnosis: ESD Internal **Sure:** 0

Impact: Magnitude of thruster firing put satellite in safe sun acquisition mode. Anomaly at 6 pm satellite local time. Recovery from safe status at 6 pm local time requires the longest outage' **Duration:** 1 hr to 1 day

Category: Phantom commands

Comments: Earth acquisition regained @ 1624Z. 'some inconvenience', but no lasting damage

References: JEM15

Name: Intelsat 602

Commercial: ☒ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: March 1991

Description: Experienced a step-like degradation [in power]

Diagnosis: Radiation Damage-Solar Proton Event **Sure:** 2

Impact: Unknown **Duration:** More than 1 wk

Category: Solar Array Degradati

Comments: None

References: JHA3

Name: Intelsat K

Commercial: ☒ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: 20 January 1994

Description: 'Minor electrical disturbance' Momentum wheel Circuit Problem

Diagnosis: ESD Internal **Sure:** 2

Impact: Pointing upset **Duration:** 10 min to 1 hr

Category: System Failure

Comments: System control was re-established by switching to backup circuitry

References: HCK11, JHA20, JHA21

Name: Intelsat K

Commercial: ☒ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: 20 Jan 1994

Description: Disabled the momentum wheel control circuitry causing it to wobble and produce fluctuations in antenna coverage

Diagnosis: ESD **Sure:** 0

Impact: Use of backup system **Duration:** 1 hr to 1 day

Category: System Failure

Comments: Full operational status was achieved on the same day after a backup system was activated

References: RSS2

Name: Intelsat Satellites (five vehicles)

Commercial: ☒ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: August 1993

Description: Minor electrical disturbance

Diagnosis: ESD Internal **Sure:** 2

Impact: Unknown **Duration:** Minimal

Category: Unknown

Comments: During a period of elevated energetic electron fluxes

References: HCK11, JEM8

Name: Iridium #11

Commercial: ☒ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: Unknown

Description: Problems with momentum wheel

Diagnosis: Unknown **Sure:** 0

Impact: Unknown **Duration:** Unknown

Category: Unknown

Comments: Space News article (about 12/4/97) Third Iridium Satellite that has had problems

References: JHA5

Name: IRON 2102

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☒ **Foreign:** ☐

Dates: 03 Apr 97

Description: Reset of the Command and Data Handler (CDH)

Diagnosis: SEU-South Atlantic Anomaly **Sure:** 2

Impact: Unknown **Duration:** Unknown

Category: Upset

Comments: Spacecraft within the heart of the South Atlantic Anomaly

References: SWS1

Name: IRON 2102

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☒ **Foreign:** ☐

Dates: 23 Oct 96

Description: Command and Data Handler Processor reset

Diagnosis: SEU-South Atlantic Anomaly **Sure:** 2

Impact: Unknown **Duration:** Unknown

Category: Upset

Comments: Spacecraft located in South Atlantic Anomaly following severe geomagnetic storming

References: SWS1

Name: IRON 2102

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☒ **Foreign:** ☐

Dates: 15 Sep 95

Description: Bus Interface Module (BIM) reset

Diagnosis: SEU-South Atlantic Anomaly **Sure:** 2

Impact: Unknown **Duration:** Unknown

Category: Upset

Comments: Enhanced Inner Van Allen Belt

References: SWS1

Name: IRON 2102

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☒ **Foreign:** ☐

Dates: 25, 27, 29, 30, 31 May 96 3, 4, 6 Sep 96 13,

Description: Safehold state

Diagnosis: IR-Environmental Sources **Sure:** 1

Impact: Unknown **Duration** 1 hr to 1 day

Category: Other

Comments: None

References: SWS1

Name: IRON 2102

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☒ **Foreign:** ☐

Dates: 18 Mar 94

Description: GPS receiver lost track and failed to reacquire

Diagnosis: ESD Internal **Sure:** 2

Impact: Unknown **Duration** Unknown

Category: Degraded Performanc

Comments: Good geomagnetic storming and strongly enhanced energetic electrons. Should not happen in Iron 2102 orbit

References: SWS1

Name: IRON 2102

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☒ **Foreign:** ☐

Dates: 05 Dec 94

Description: Anomalous reset of the Command and Data handling Processor #2

Diagnosis: SEU-South Atlantic Anomaly **Sure:** 1

Impact: Unknown **Duration:** Unknown

Category: Upset

Comments: None

References: SWS1

Name: IRON 2102

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☒ **Foreign:** ☐

Dates: 29 Jul 95

Description: Radar Illumination Verification System (RIVs) processor failure

Diagnosis: SEU-South Atlantic Anomaly **Sure:** 1

Impact: Unknown **Duration:** More than 1 wk

Category: System Failure

Comments: Spacecraft within South Atlantic Anomaly

References: SWS1

Name: IRON 3122

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☒ **Foreign:** ☐

Dates: 18 Sep 97

Description: Command processor reset

Diagnosis: ESD **Sure:** 1

Impact: None **Duration:** Unknown

Category: Upset

Comments: Spacecraft within region where Field aligned currents are located

References: SWS1

Name: IRON 3122

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☒ **Foreign:** ☐

Dates: 15 Dec 97

Description: Command processor reset

Diagnosis: SEU-South Atlantic Anomaly **Sure:** 2

Impact: Unknown **Duration:** Unknown

Category: Upset

Comments: Spacecraft ascending within the heart of the South Atlantic Anomaly

References: SWS1

Name: IRON 4221

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☒ **Foreign:** ☐

Dates: 31 May 95

Description: Anomalous reset of the Command and Data Handling (CDH) processor

Diagnosis: SEU-South Atlantic Anomaly **Sure:** 1

Impact: Unknown **Duration:** Unknown

Category: Upset

Comments: Spacecraft within the heart of the South Atlantic Anomaly

References: SWS1

Name: IRON 4221

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☒ **Foreign:** ☐

Dates: 23 Nov 95

Description: Anomalous reset of the Command and Data Handling (CDH) processor

Diagnosis: SEU **Sure:** 1

Impact: Unknown **Duration:** Unknown

Category: Upset

Comments: None

References: SWS1

Name: IRON 4221

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☒ **Foreign:** ☐

Dates: 17 Jul 95

Description: Anomalous reset of the Attitude Control system (ACS) processor

Diagnosis: Unknown **Sure:** 0

Impact: Unknown **Duration** Unknown

Category: Upset

Comments: Disturbed geomagnetic and energetic particle environment

References: SWS1

Name: IRON 4221

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☒ **Foreign:** ☐

Dates: 26 Jun 95

Description: Anomalous reset of the Attitude control system (ACS) processor

Diagnosis: ESD **Sure:** 1

Impact: Unknown **Duration** Unknown

Category: Upset

Comments: Disturbed geomagnetic and particle environments

References: SWS1

Name: IRON 4221

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☒ **Foreign:** ☐

Dates: 06 Jul 95

Description: Anomalous soft reset of the Command and Data Handling (CDH) microprocessor

Diagnosis: SEU-South Atlantic Anomaly **Sure:** 1

Impact: Unknown **Duration:** Unknown

Category: Upset

Comments: Portions of the inner Van Allen Belt and the South Atlantic Anomaly in which this spacecraft was located are somewhat enhanced during solar minimum

References: SWS1

Name: IRON 4524

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☒ **Foreign:** ☐

Dates: 15 May 94

Description: Communications system hardware to switch oscillators

Diagnosis: ESD Internal **Sure:** 2

Impact: Unknown **Duration:** Unknown

Category: Phantom commands

Comments: >2 MeV electrons enhanced

References: SWS1

Name: IRON 7092

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☒ **Foreign:** ☐

Dates: 15 Dec 94

Description: Communication interruption between the Battery Charge Regulator (BCR) and the Spacecraft Control Module (SCM)

Diagnosis: Unknown **Sure:** 0

Impact: Unknown **Duration:** Unknown

Category: Unknown

Comments: Spacecraft descending through the heart of the Van Allen Belt

References: SWS1

Name: IRON 7092

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☒ **Foreign:** ☐

Dates: 08 Dec 95

Description: Anomalous loss of telemetry

Diagnosis: SEU **Sure:** 1

Impact: Unknown **Duration:** Unknown

Category: Upset

Comments: Spacecraft transited the inner Van Allen Belt and the South Atlantic Anomaly

References: SWS1

Name: IRON 7092

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☒ **Foreign:** ☐

Dates: 01 Apr 95

Description: Battery Charge Regulator (BCR) reset causing the payloads to be turned off

Diagnosis: ESD Internal **Sure:** 1

Impact: Unknown **Duration:** 1 hr to 1 day

Category: Upset

Comments: Spacecraft within the horns of the outer Van Allen Belt

References: SWS1

Name: IRON 7092

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☒ **Foreign:** ☐

Dates: 06 Nov 94

Description: Attitude Control Subsystem declared contingency mode and cycled to initialization routines

Diagnosis: Unknown **Sure:** 0

Impact: Unknown **Duration:** Unknown

Category: Phantom commands

Comments: Moderately disturbed geomagnetic and energetic particle environments at the time of the anomaly

References: SWS1

Name: IRON 7092

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☒ **Foreign:** ☐

Dates: 10 Dec 94

Description: Communication interruption between the Housekeeping Interface Unit (HIU) and the Payload Services Module (PSM)

Diagnosis: SEU **Sure:** 1

Impact: Unknown **Duration:** Unknown

Category: Upset

Comments: Spacecraft ascending through the heart of the Van Allen Belt

References: SWS1

Name: IRON 7092

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☒ **Foreign:** ☐

Dates: 13 Dec 94

Description: Battery Charge Regulator (BCR) timer working double time

Diagnosis: SEU **Sure:** 1

Impact: Unknown **Duration:** Unknown

Category: Upset

Comments: Spacecraft descending through the heart of the Van Allen Belt

References: SWS1

Name: IRON 7092

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☒ **Foreign:** ☐

Dates: 29 Sep 94

Description: Anomalous reset of the Payload Services Module (PSM) clock

Diagnosis: SEU-South Atlantic Anomaly **Sure:** 1

Impact: Unknown **Duration:** Unknown

Category: Upset

Comments: Spacecraft within the South Atlantic Anomaly

References: SWS1

Name: IRON 7092

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☒ **Foreign:** ☐

Dates: 04 Nov 94

Description: Communication interruption between the spacecraft Control Module (SCM) and Battery Charge Regulator (BCR)

Diagnosis: SEU **Sure:** 1

Impact: Unknown **Duration:** Unknown

Category: Upset

Comments: Spacecraft within the heart of the Inner Van Allen Belt

References: SWS1

Name: IRON 7092

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☒ **Foreign:** ☐

Dates: 26 Mar 95

Description: Battery Charge Regulator (BCR) reset causing the payloads to be turned off

Diagnosis: ESD Surface **Sure:** 0

Impact: Unknown **Duration** 1 hr to 1 day

Category: Upset

Comments: Spacecraft located in the auroral zone that was observed to be intensified with enhanced precipitating energetic particle fluxes

References: SWS1

Name: IRON 7092

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☒ **Foreign:** ☐

Dates: 18 Dec 94

Description: Corruption of the Battery Charge Regulator (BCR) software

Diagnosis: SEU **Sure:** 1

Impact: Unknown **Duration** Unknown

Category: Upset

Comments: Spacecraft descending through the heart of the Van Allen Belt

References: SWS1

Name: IRON 7092

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☒ **Foreign:** ☐

Dates: 04-05 Nov 94

Description: 18 anomalous periods of noise spikes that appeared within the multiple electrical power system telemetry points

Diagnosis: SEU **Sure:** 2

Impact: Unknown **Duration:** Unknown

Category: Spurious Signal

Comments: All of the anomalies were recorded while the spacecraft was within one of the following environments-the inner Van Allen Belt, South Atlantic Anomaly, and in or just below the 'horn region' of the outer Van Allen Belt

References: SWS1

Name: IRON 7092

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☒ **Foreign:** ☐

Dates: 17 Feb 95

Description: Communication interruption between the Spacecraft Computer and the Housekeeping interface unit (HIU) along with an associated Electrical Power System (EPS) battery charge code error

Diagnosis: SEU **Sure:** 1

Impact: Unknown **Duration:** Unknown

Category: Upset

Comments: Spacecraft located within the Inner Van Allen belt

References: SWS1

Name: IRON 9364

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☒ **Foreign:** ☐

Dates: 16 Oct 92 19 Oct 92

Description: Glitch in earth sensor

Diagnosis: ESD Surface **Sure:** 2

Impact: Unknown **Duration:** Unknown

Category: Unknown

Comments: None

References: SWS1

Name: IRON 9364

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☒ **Foreign:** ☐

Dates: 27 Oct 92 and 30 Oct 92

Description: Glitch in earth sensor reference

Diagnosis: ESD **Sure:** 0

Impact: Unknown **Duration:** Unknown

Category: Unknown

Comments: None

References: SWS1

Name: IRON 9443

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☒ **Foreign:** ☐

Dates: 18 Oct 92

Description: Command check read malfunction

Diagnosis: ESD Surface **Sure:** 2

Impact: Unknown **Duration:** Unknown

Category: Spurious Signal

Comments: Spacecraft experienced a marked increase of energetic electron fluxes while traversing the local midnight sector

References: SWS1

Name: IRON 9445

Commercial: ☐

NASA/NOAA: ☐

Scientific: ☐

DoD: ☐

Classified/Other: ☒

Foreign: ☐

Dates: 06 Oct 95

Description: Electrical Integration Assembly (EIA)
command processing

Diagnosis: ESD Internal

Sure: 1

Impact: Unknown

Duration Unknown

Category: Unknown

Comments: None

References: SWS1

Name: IRON 9445

Commercial: ☐

NASA/NOAA: ☐

Scientific: ☐

DoD: ☐

Classified/Other: ☒

Foreign: ☐

Dates: 08 Oct 95

Description: Electrical Integration Assembly (EIA)
command processing anomaly

Diagnosis: ESD Internal

Sure: 3

Impact: Unknown

Duration Unknown

Category: Unknown

Comments: None

References: SWS1

Name: IRON-9906

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☒ **Foreign:** ☐

Dates: 1992 to 1997

Description: The payload control electronics module (PCEM) suffered a watchdog timer(WDT) time-out which caused a payload reset. Occurred numerous times over spacecraft lifetime

Diagnosis: SEU-South Atlantic Anomaly **Sure:** 3

Impact: All stored data lost **Duration** 1 hr to 1 day

Category: Upset

Comments: None

References: SWS1

Name: IRON-9906

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☒ **Foreign:** ☐

Dates: 1997

Description: The payload control electronics module (PCEM) suffered a watchdog timer(WDT) time-out which caused a payload reset.. After last latch-up, spacecraft lost

Diagnosis: SEU **Sure:** 3

Impact: Mission Loss **Duration** Mission loss

Category: Mission Loss

Comments: None

References: SWS1

Name:	ISEE-1		
Commercial:	<input type="checkbox"/>	NASA/NOAA:	<input type="checkbox"/>
DoD:	<input type="checkbox"/>	Classified/Other:	<input type="checkbox"/>
Dates:	7 August 1978		
Description:	The ULEWAT instrument on ISEE-1 lost all isobutane gas over a 7 day period ~ 1 year after launch. Gas supply was intended to last for at least 5 years		
Diagnosis:	Impact-Micrometeoroid	Sure:	2
Impact:	Instrument returned useful low-energy particle data for ~ 1 years out of a potential of at least ~5 years (~20% science return from this instrument)	Duration	More than 1 wk
Category:	System Failure		
Comments:	Micrometeoroid impact likely but not conclusively proven. ISEE-1 was ~15 Re from Earth at the time the ULEWAT gas pressure began to decrease. The gas leak was small enough that the regulation system compensated for the loss for ~7 days, after which the supply ran out		
References:	RSS2		

Name: ISEE-1 (International Sun-Earth Explorer)

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☒

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: After Oct 1977

Description: Detector window punctured

Diagnosis: Impact-Micrometeoroid **Sure:** 0

Impact: 25% data loss **Duration:** More than 1 wk

Category: Degraded Performanc

Comments: None

References: RSS38

Name: Kosmos -1275

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: 24 Jul 1981

Description: Broke up into over 200 trackable fragments while at an altitude of 977 km

Diagnosis: Impact-Hypervelocity collision with a piece **Sure:** 0

Impact: Unknown **Duration:** Mission loss

Category: Mission Loss

Comments: None

References: RSS37

Name: Landsat-3

Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: After May 1978

Description: The multispectral scanner on board the Landsat-3 satellite experienced extra scan monitor pulses that caused early line starts or extra end of line codes

Diagnosis: Unknown **Sure:** 0

Impact: Loss of data **Duration:** More than 1 wk

Category: Degraded Performanc

Comments: These events occurred over magnetic anomalies ??

References: RSS38

Name: LDEF (STS-41C)

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☒

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: After Mar 1984

Description: An aluminized-polyimide Kapton multilayer insulation sample located on the leading edge of the Long Duration Exposure Facility was eroded over the mission lifetime

Diagnosis: Atomic-oxygen Erosion **Sure:** 3

Impact: None **Duration:** More than 1 wk

Category: Other

Comments: This experimental study showed much wider and shallower undercut cavities than predicted, with implications for future low Earth orbit missions

References: RSS40

Name: LEO spacecraft

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☒ **Foreign:** ☐

Dates: Unknown

Description: Problems in power system soon after launch.
Bus load increased substantially.
Concurrently problems were seen in RAM
memory system

Diagnosis: SEU **Sure:** 3

Impact: Mission ops procedures were modified to
include frequent power cycling of the RAMs
to unlatch them. RAMs were turned off
between ops. Required more complex ops
planning. Some RAMs were permanently
damaged **Duration** More than 1 wk

Category: Degraded Performanc

Comments: Single Event Latchup occurring in RAMs.
RAMs extremely susceptible to latchup
were drawing greatly excessive current

References: JBB1

Name: LEO spacecraft

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☒ **Foreign:** ☐

Dates: Unknown

Description: Uncommanded shutdowns of TWT HV supply

Diagnosis: Plasma Effects **Sure:** 3

Impact: Vehicle operations were modified to keep the pumpout holes out of the RAM direction. Required more complex OPS planning for life of vehicle. Threat of permanent failure **Duration** More than 1 wk

Category: Phantom commands

Comments: Interaction between the ionospheric plasma coming through pumpout holes and the HV caused the TWT shutdowns. Shutdown occurred when pumpout holes were in the RAM direction

References: JBB1

Name: LEO spacecraft

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☒ **Foreign:** ☐

Dates: 19-29 October 1989

Description: Multiple switching off of microwave transmitter unit

Diagnosis: Solar Proton Event **Sure:** 0

Impact: Unknown **Duration** 1 hr to 1 day

Category: Phantom commands

Comments: None

References: HCK33

Name: Magsat

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☒

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: After Oct 1979

Description: Loss of star camera data

Diagnosis: Sunlight **Sure:** 2

Impact: Loss of data for 30-40 minutes **Duration:** More than 1 wk

Category: Degraded Performanc

Comments: Direct sunlight on the sides of the sunshades that penetrated their black plastic skin

References: RSS38

Name: MARECS-A

Commercial: ☒ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: 31 August 85

Description: One section of a solar array panel failed while entering eclipse

Diagnosis: ESD Surface **Sure:** 0

Impact: Unknown **Duration:** More than 1 wk

Category: System Failure

Comments: ESD Event which resulted in a short circuit through the cell to the back structure of the solar array panel'

References: DCW13

Name: MARECS-A

Commercial: ☒ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: 3, 17, 29 Mar 89

Description: 50 switching events

Diagnosis: ESD Surface **Sure:** 0

Impact: Unknown **Duration** 10 min to 1 hr

Category: Phantom commands

Comments: Great magnetic storm

References: DCW11

Name: MARECS-A

Commercial: ☒

NASA/NOAA: ☐

Scientific: ☐

DoD: ☐

Classified/Other: ☐

Foreign: ☒

Dates: Feb 82 to Mar 91

Description: Spurious anomalies in the telemetry system requiring onboard processors to be manually reset. Pointing system suddenly went into an energy conserving 'safeing' mode shutting down all communications subsystems. Solar panel surfaces degraded to the point that power output dropped to unacceptable operating levels

Diagnosis: ESD Surface

Sure: 3

Impact: Eventually taken out of service. The charging study improved the design of future satellites in the series

Duration 10 min to 1 hr

Category: Phantom commands

Comments: Electrostatic discharges due to spacecraft charging. Localized arcing caused by surface charging while the satellite was in eclipse

References: RSS18, RSS19

Name: MARECS-A

Commercial: ☒ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: Feb 82 to Dec 84

Description: 617 Phantom commands indicating that a main bus under-voltage had occurred

Diagnosis: ESD Surface **Sure:** 3

Impact: Required 3 telecommands to reset the telemetry latch **Duration** Less than 10 min

Category: Spurious Signal

Comments: None

References: DCW13

Name: MARECS-A

Commercial: ☒ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: Feb 82to Dec 84

Description: Part of the AOCS autonomous protection logic disabled 157 times

Diagnosis: ESD Surface **Sure:** 3

Impact: Immediately re-enabled by telecommand **Duration** Less than 10 min

Category: Phantom commands

Comments: None

References: DCW13

Name: MARECS-A

Commercial: ☒ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: Feb 82 to Dec 84

Description: ESD-Coupled stimuli into onboard logic.
(205 events)

Diagnosis: ESD Surface **Sure:** 3

Impact: Some impact on mission when logic was enabled **Duration:** Less than 10 min

Category: Phantom commands

Comments: None

References: DCW13

Name: MARECS-A

Commercial: ☒ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: 25 March 1991

Description: Complete failure

Diagnosis: ESD Internal **Sure:** 2

Impact: Mission Loss. Traffic switched to Intelsat commercial telecommunication satellite **Duration:** Mission loss

Category: Mission Loss

Comments: Period of high energetic electron fluxes following an solar proton event. It was being employed as a backup communications satellite at the time. Had a history of space-environment induced anomalies

References: HCK15, HCK33, JHA20, JHA4

Name: METEOSAT 2

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: 8/10/86- 10/22/86

Description: Single Parameter Switchings

Diagnosis: ESD Internal **Sure:** 0

Impact: Did not effect operations **Duration** Minimal

Category: Phantom commands

Comments: None

References: DCW12

Name: METEOSAT 3

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: 12-22 JAN 1994

Description: Arcing Problems

Diagnosis: ESD Internal **Sure:** 0

Impact: Images Lost **Duration** Unknown

Category: Degraded Performanc

Comments: None

References: JHA 20

Name: Meteosat F-1

Commercial: ☒ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: Various from 12 Dec 77 to 3 Mar 78

Description: Large number of spurious switching events

Diagnosis: ESD Surface **Sure:** 3

Impact: None of the switching events caused a serious interruption to the METEOSAT mission but The inconvenience to the Space Operations Teams was considerable. Led to study by the Project Team and by Industry to determine the probable cause of these events and more importantly to determine if corrective action could be designed into future versions of METEOSAT. A series of current-injection tests and electron-radiation tests were carried out during 1978/79 on METEOSAT P1 spacecraft **Duration** 10 min to 1 hr

Category: Phantom commands

Comments: Extensive Modifications and Improvements incorporated into future spacecraft and resolved previous problems

References: DCW13

Name: Meteosat-F1

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: Various from Sept. 1981 to March 1982

Description: Only the occurrence of 'problems' were noted, no specific problem identified

Diagnosis: ESD Surface **Sure:** 0

Impact: Unknown in any detail **Duration** Unknown

Category: Unknown

Comments: Based on hearsay. Anomaly list gives 13 dates and times but no specific effect

References: JFF ??

Name: Meteosat-F1 (European Space Agency Mete

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: After Nov 1977

Description: 150 anomalies in first 3 years

Diagnosis: ESD Surface **Sure:** 3

Impact: Meteosat F-2 was modified prior to launch in June 1994 to eliminate some of the problems that F-1 experienced, and equipped with instrumentation to measure electrons in the energy range that could cause spacecraft charging **Duration** 10 min to 1 hr

Category: Phantom commands

Comments: None

References: RSS23, RSS24, RSS25

Name: MILSTAR DFS-1

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 3/94-9/97

Description: Processor Upsets (142) with automatic reboot

Diagnosis: SEU-Cosmic Ray **Sure:** 3

Impact: Minimal operational impact. Some ground terminals that have just logged in have to reboot. Cost to study upsets in the range from \$200K to \$500K **Duration** Minimal

Category: Upset

Comments: Reboot takes 1-2 sec. Restores state from 30-60 sec ago

References: HCK34

Name: MILSTAR DFS-2

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 11/95-9/97

Description: 75 Processor Upsets with automatic reboot

Diagnosis: SEU-Cosmic Ray **Sure:** 2

Impact: Minimal operational impact. Some ground terminals that have just logged in have to reboot. Cost to study upsets in the range from \$200K to \$500K **Duration** Minimal

Category: Upset

Comments: Reboot takes 1-2 sec. Restores state from 30-60 sec ago

References: HCK34

Name: MILSTAR-DFS 1

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 19 April 94, 26 April 94, 15 June 94

Description: Processor Upsets that have required manual resets

Diagnosis: SEU-Cosmic Ray **Sure:** 3

Impact: 2-3 hr required to regain operational status **Duration** 1 hr to 1 day

Category: Upset

Comments: Problem related to software errors that precluded automatic reboot. Software errors that produced these reboots have been fixed

References: HCK34

Name: Mir SS

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: After Feb 1986

Description: Chronic power shortages

Diagnosis: Impact-Debris **Sure:** 0

Impact: Unknown **Duration** More than 1 wk

Category: Solar Array Degradati

Comments: Solar panels have been battered by tiny meteorites, space debris, and atomic oxygen

References: RSS36

Name: MSTI

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 04 Jan 93

Description: TCM relay or PCM decoder malfunction, or encryption device malfunction (Bit Hit) lost all telemetry contact

Diagnosis: SEU **Sure:** 0

Impact: Mission Loss **Duration** Mission loss

Category: Mission Loss

Comments: None

References: SWS1

Name: MSTI 2

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 5 Sep 1994

Description: Contact with satellite was lost

Diagnosis: Impact-Micrometeoroid **Sure:** 0

Impact: Mission Loss **Duration** Mission loss

Category: Mission Loss

Comments: Orbital debris impact to a wire bundle causing an electrical short and/or spacecraft charging

References: RSS67

Name: MSTI-2

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 14 Aug 94

Description: CPU reset resulting in loss of attitude control

Diagnosis: SEU-South Atlantic Anomaly **Sure:** 1

Impact: Loss of data **Duration** 1 hr to 1 day

Category: Upset

Comments: Spacecraft was descending into the outer edge of the South Atlantic Anomaly

References: SWS1

Name: MSTI-2

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 18 JUN 94

Description: CPU reset

Diagnosis: SEU **Sure:** 1

Impact: Unknown **Duration** Unknown

Category: Upset

Comments: None

References: SWS1

Name: NATO 3A

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: Multiple in 1978

Description: Attitude determination errors

Diagnosis: ESD Surface **Sure:** 2

Impact: Improper narrow beam antenna pointing **Duration** Unknown

Category: Spurious Signal

Comments: Times of errors were not all well known, but all overlapped local midnight. The most accurately timed events occurred in the pre to just post midnight regions. Surface charging/discharging suspected to have caused erroneous attitude data from earth sensors

References: JFF8

Name: NATO 3A

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: 11 Jan 1987

Description: Attitude control problems

Diagnosis: ESD Internal **Sure:** 0

Impact: Unknown **Duration** Unknown

Category: Other

Comments: None

References: RSS7

Name: NATO 3B

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: 11 Jan 1987, Aug and Sep 1987

Description: Three attitude control anomalies, three phantom command anomalies

Diagnosis: ESD Internal **Sure:** 0

Impact: Unknown **Duration:** Unknown

Category: Phantom commands

Comments: None

References: RSS7

Name: NATO 3B

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: Multiple in 1978

Description: Attitude determination errors

Diagnosis: ESD Surface **Sure:** 2

Impact: Improper narrow beam antenna pointing **Duration:** Unknown

Category: Spurious Signal

Comments: Times of errors were not all well known, but all overlapped local midnight. The most accurately timed events occurred in the pre to just post midnight regions. Surface charging/discharging suspected to have caused erroneous attitude data from earth sensors

References: JFF8

Name: NATO 3C

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: Dec 1986 to Sep 1987

Description: Five attitude control anomalies

Diagnosis: ESD Internal **Sure:** 0

Impact: Unknown **Duration:** Unknown

Category: Unknown

Comments: None

References: RSS7

Name: NIMBUS 7

Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: After Oct 1978

Description:

Diagnosis: Unknown **Sure:** 0

Impact: Unknown **Duration:** Unknown

Category: Unknown

Comments: High energy particles caused electrical component damage ??

References: RSS54

Name: NOAA 10

Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 13 Mar 89

Description: Excessive x-axis gyro speed after magnetic moment unloading causing the roll/yaw coil to switch to backup mode

Diagnosis: Unknown **Sure:** 0

Impact: Unknown **Duration** Unknown

Category: Degraded Performanc

Comments: High Solar activity

References: RSS49

Name: NOAA 10

Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 1 Oct 89

Description: The SCU 28 volt switch power indicated an 'on' reading

Diagnosis: Unknown **Sure:** 0

Impact: Unknown **Duration** Unknown

Category: Phantom commands

Comments: Command line glitch or solar influence

References: RSS49

Name: NOAA 11

Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 11-20 March 1989

Description: ??

Diagnosis: ESD Internal **Sure:** 2

Impact: Unknown **Duration:** Unknown

Category: Unknown

Comments: Anomalies occur within trapped radiation regions

References: HCK33

Name: NOAA 11

Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 10 April 1990

Description: Experienced pitch reaction wheel glitches. Usual process of transferring spin to the momentum wheel was reversed and the wheel 'spun-up' the satellite

Diagnosis: Magnetic Field Variability **Sure:** 0

Impact: Unknown **Duration:** Unknown

Category: Degraded Performanc

Comments: Major magnetic storm on 10-11 April 1990

References: HCK33

Name: NOAA 11

Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 22-24 March 1991

Description: Loss of automatic attitude control

Diagnosis: Solar Proton Event **Sure:** 2

Impact: Unknown **Duration** Unknown

Category: Degraded Performanc

Comments: Command line glitch or solar influence ??

References: HCK15, JHA 20

Name: NOAA 7

Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: After Jun 1981

Description: Magnetic coil unloadings were not completely effective

Diagnosis: Higher than expected torque from solar press **Sure:** 0

Impact: Unknown **Duration** 1 hr to 1 day

Category: Degraded Performanc

Comments: None

References: RSS38

Name: NOAA 8

Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: July 1984 ?

Description: sudden failure

Diagnosis: Unknown **Sure:** 0

Impact: Loss of S/C **Duration:** Unknown

Category: Mission Loss

Comments: Computer problems that became acute early on 12 June 1984-JHA

References: JEM9

Name: NOAA 9

Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: Mar 89

Description: Unusual momentum wheel activity that resulted in roll/yaw coil switching to its backup mode. Proper attitude control was maintained through the event

Diagnosis: Unknown **Sure:** 0

Impact: Unknown **Duration:** Unknown

Category: Degraded Performanc

Comments: High Solar Activity

References: RSS49

Name: NOAA-? Three satellites

Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: Mar 89

Description: Had trouble unloading torque due to the large ambient magnetic field charges in orbit

Diagnosis: Magnetic Field Variability **Sure:** 2

Impact: Unknown **Duration:** 1 hr to 1 day

Category: Degraded Performanc

Comments: Great Magnetic Storm

References: JHA15

Name: NOAA-10

Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 29-30 Sept 1989

Description: Phantom Command

Diagnosis: Solar Proton Event **Sure:** 3

Impact: Unknown **Duration:** Unknown

Category: Phantom commands

Comments: Rare 'Phantom Command'

References: HCK33, JHA20

Name: Olympus

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☒

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: 11-12 August 1993

Description: Service interrupted, began to spin slowly

Diagnosis: Unknown **Sure:** 0

Impact: Satellite retired from service because it was low on fuel for attitude control and station keeping **Duration** Mission loss

Category: Mission Loss

Comments: At the time of the Perseid meteor shower

References: JEM10

Name: ROSAT

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☒

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: 26 January 1991

Description: CPU for attitude control had an upset

Diagnosis: SEU **Sure:** 1

Impact: Lost control for 14 hours **Duration** 1 hr to 1 day

Category: Upset

Comments: (Roentgen Satellite)

References: JHA 13

Name: SAMPEX

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☒

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 20 JULY 1992-present

Description: Dual high voltage supplies in LICA instrument move to maximum ~4KV output level while control voltages remain nominal; most likely to occur in auroral zone & while S/C is at 0-8 local time

Diagnosis: ESD Surface **Sure:** 2

Impact: Premature aging of micro-channel plates due to hv spikes. Instrument off-line for ~3 months in 1992 during anomaly investigation. Instrument powered off 15 min/day from on-board HV monitor. Lost ~5% of science data from this instrument **Duration** More than 1 wk

Category: Degraded Performanc

Comments: Correlation with s/c shadowing and auroral zone precipitation suggest surface charging plays a role in the anomaly

References: JEM11

Name: SBS 1

Commercial: ☒ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: After 1981

Description: Hundreds of events over an eight year period affecting the attitude control system

Diagnosis: ESD **Sure:** 0

Impact: Unknown **Duration:** Unknown

Category: Phantom commands

Comments: (Satellite Business Systems telecommunications satellite)

References: RSS7

Name: SCATHA

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☒

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: After 1981

Description: Hundreds of events over an eight year period affecting the attitude control system

Diagnosis: ESD Surface **Sure:** 1

Impact: Minimal **Duration:** Minimal

Category: Phantom commands

Comments: (Spacecraft Charging at High Altitude satellite, P78-2)

References: RSS7

Name: SCATHA (Spacecraft Charging at High Altit
Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☒
DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐
Dates: 22 Sep 1982
Description: A filter change of state in one of the
magnetic field monitors, timing errors in the
Plasma Wave Analyzer
Diagnosis: ESD Surface **Sure:** 3
Impact: A 2-minute loss of data **Duration** Less than 10 min
Category: Phantom commands
Comments: A particularly large number of arcing events
References: RSS22

Name: SEDS-2
Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☒
DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐
Dates: 14 Mar 1994
Description: 20 km tether was severed
Diagnosis: Impact-Micrometeoroid **Sure:** 2
Impact: Experiment ended prematurely **Duration** Mission loss
Category: Mission Loss
Comments: (Small Expendable Deploy Satellite)
References: RSS62

Name: Skylab

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☒

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 11 Jul 1979

Description: Prematurely re-entered the Earth's atmosphere

Diagnosis: Atmospheric drag **Sure:** 2

Impact: None **Duration:** More than 1 wk

Category: Other

Comments: None

References: RSS41

Name: Skynet 2B

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: 1975 to 1976

Description: Anomalies in timing circuits of the telemetry and command subsystem. 300 were investigated

Diagnosis: ESD Surface **Sure:** 0

Impact: Unknown **Duration:** Unknown

Category: Degraded Performanc

Comments: (UK defense communications satellite)

References: RSS30

Name: SMM

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☒

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: After Feb 1980

Description: The C Gyro failed

Diagnosis: Unknown **Sure:** 0

Impact: Control was regained and the B Gyro was used **Duration** 1 day to 1 wk

Category: Random Part Failure

Comments: Transient radiation susceptibility of complementary MOS semi-conductors in the electronics. (Solar Maximum Mission)

References: RSS38

Name: SMM

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☒

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 1985

Description: Anomaly in the onboard computer placed the spacecraft in 'safe hold' condition

Diagnosis: SEU **Sure:** 0

Impact: Science data interrupted for 8 days **Duration** More than 1 wk

Category: Upset

Comments: (Solar Maximum Mission)

References: RSS57

Name: SMM

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☒

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: Jan 1986

Description: Some 'safe holds' during spacecraft operation due to problems in the on board computer

Diagnosis: SEU-Cosmic Ray **Sure:** 0

Impact: 8K of memory (out of 48K total) was lost.
Loss of data during safe hold recovery **Duration:** More than 1 wk

Category: Random Part Failure

Comments: (Solar Maximum Mission)

References: RSS58

Name: Solar-A

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☒

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: After Aug 1991

Description: 0.05 mm hole in the thin film membrane covering the optical system

Diagnosis: Impact-Micrometeoroid **Sure:** 0

Impact: Loss of the visual portion of the telescope **Duration:** More than 1 wk

Category: System Failure

Comments: (Yohkoh)

References: RSS63

Name: SPOT-3
Commercial: ☒ **NASA/NOAA:** ☐ **Scientific:** ☐
DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒
Dates: 10 Jan 95
Description: Transmitter / Downlink problems
Diagnosis: SEU-South Atlantic Anomaly **Sure:** 1
Impact: Unknown **Duration:** Unknown
Category: Degraded Performanc
Comments: Spacecraft within the heart of the South Atlantic Anomaly
References: SWS1

Name: STRV 1A
Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐
DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐
Dates: June 1994
Description: Background increases in MCP detectors
Diagnosis: Energetic electrons **Sure:** 0
Impact: Unknown **Duration:** More than 1 wk
Category: Degraded Performanc
Comments: None
References: JEM5

Name: STS-45

Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: Mar 1992

Description: The space shuttle Atlantis suffered two gouges (1.9x1.6 in. and 0.4x1 in.) on the upper portion of the right wing leading edge

Diagnosis: Impact-Micrometeoroid **Sure:** 3

Impact: None **Duration:** Minimal

Category: Other

Comments: Low relative velocity debris impact on-orbit or during re-entry, or prelaunch or ascent debris. Raised concern about the consequences of a higher energy impact to the integrity of the space craft

References: RSS64

Name: STS-49

Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: May 1992

Description: Chip in upper right hand corner of the thermal window pane

Diagnosis: Impact-Debris or Micrometeoroid **Sure:** 0

Impact: Unknown **Duration:** Minimal

Category: Other

Comments: Impact occurring on or around flight day 8

References: RSS34

Name: STS-61

Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 6 Dec 1993

Description: Star tracker failed

Diagnosis: SEU-South Atlantic Anomaly **Sure:** 0

Impact: Following a power cycle the star tracker passed a self test and functioned nominally for the rest of the mission The Y star tracker failed to acquire navigation stars for approximately 5 hours **Duration** 1 day to 1 wk

Category: System Failure

Comments: Single event upset in the South Atlantic Anomaly. The high altitude flown on STS-61 resulted in increased radiation exposure

References: RSS43

Name: Symphonie A

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: After Nov 1974

Description: History of non-critical anomalies (i.e. modulation losses and logic upsets)

Diagnosis: ESD Surface **Sure:** 2

Impact: A reset command is sent from the control center if necessary **Duration** 10 min to 1 hr

Category: Upset

Comments: (French-German experimental communications satellite)

References: RSS29

Name: Symphonie B

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: After Aug 1975

Description: History of non-critical anomalies (i.e. modulation losses and logic upsets)

Diagnosis: ESD Surface **Sure:** 2

Impact: A reset command is sent from the control center if necessary **Duration** 10 min to 1 hr

Category: Upset

Comments: (French-German experimental communications satellite)

References: RSS29

Name: TDRS 1

Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 1984-1990

Description: Anomalous responses in the Attitude Control System (ARCS) traced to state changes in the Random Access Memory (RAM) in the ACS

Diagnosis: SEU-Cosmic Ray **Sure:** 0

Impact: Ground control was required to maintain the satellite's proper attitude. Had to change TDRS 2 parts before launch **Duration** More than 1 wk

Category: Degraded Performanc

Comments: Same chip used in HST

References: RSS53, JHA23

Name: TDRS 1

Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 1984 to 1990

Description: Anomalous responses in the Attitude Control System (ACS) traced to state changes in the Random Access Memory (RAM) in the ACS

Diagnosis: SEU-Cosmic Ray **Sure:** 3

Impact: Ground control was required to maintain the satellite's proper attitude. Prompted changes in the ACS design of future TDRS missions **Duration** More than 1 wk

Category: Degraded Performanc

Comments: None

References: RSS53

Name: TDRS 1

Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 1984-1990

Description: Anomalous responses in the Attitude Control System (ARCS) traced to state changes in the Random Access Memory (RAM) in the ACS

Diagnosis: SEU-Cosmic Ray **Sure:** 0

Impact: Temporary loss of attitude control **Duration** More than 1 wk

Category: Degraded Performanc

Comments: None

References: RSS49

Name: TDRS 2

Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 19-29 October 1989

Description: SEUs

Diagnosis: SEU-Solar Proton Event **Sure:** 1

Impact: Unknown **Duration:** Unknown

Category: Upset

Comments: 'Even the hardened TDRS-2 and -3 experienced SEUs'

References: HCK33

Name: TDRS 3

Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 19-29 October 1989

Description: SEUs

Diagnosis: SEU-Solar Proton Event **Sure:** 2

Impact: Unknown **Duration:** Unknown

Category: Upset

Comments: 'Even the hardened TDRS-2 and -3 experienced SEUs'

References: HCK33

Name: TDRS 4
Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐
DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐
Dates: 8 May 1989
Description: Earth Sensor Assembly (ESA) roll output alarm
Diagnosis: SEU-Solar Proton Event **Sure:** 0
Impact: Temporary loss of attitude control **Duration:** Unknown
Category: Spurious Signal
Comments: None
References: RSS49

Name: TDRS 4
Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐
DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐
Dates: 1 Aug 1993
Description: Erratic ACS data and the spacecraft slowly started to diverge from Earth pointing
Diagnosis: SEU **Sure:** 2
Impact: User services out for 8 hours before CTE and CPE units re-enabled **Duration:** 1 hr to 1 day
Category: Upset
Comments: None
References: RSS33

Name: TDRS 4

Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 26 Aug 1993

Description: An Earth sensor assembly roll and pitch 'glitch' lasted 2 seconds causing ESA 'fail-safe' to occur

Diagnosis: SEU **Sure:** 0

Impact: Reaction wheels run down to zero, re-enabled by ground command, S/C recovery in 5 minutes **Duration** Less than 10 min

Category: Upset

Comments: None

References: RSS33

Name: TDRS 5

Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 10 Aug 1991

Description: A control sensor parameter momentarily exceeded its caution limit

Diagnosis: SEU **Sure:** 0

Impact: Unknown **Duration** Unknown

Category: Upset

Comments: None

References: RSS44

Name: TDRS 5

Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 12 Dec 93

Description: Normal mode outputs from the Control Processing Electronics (CPE) went into a disabled state, with numerous attitude control system (ACS) parameters out of limits. S/C started to lose its attitude reference

Diagnosis: SEU **Sure:** 0

Impact: CPE re-initialized and reloaded. no loss of user data **Duration** Minimal

Category: Upset

Comments: None

References: RSS33

Name: TDRS 6

Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 10 Jul 93

Description: Earth Sensor Assembly A Pitch Channel output cautioned at 0/.3199 deg for one update period

Diagnosis: SEU **Sure:** 1

Impact: None **Duration** Minimal

Category: Upset

Comments: Single Event Upset in the Command and Telemetry electronics (CTE) buffer. Self-healing

References: RSS33

Name: TDRS 6

Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 4 Jun 1994

Description: Control processor initialized itself, causing attitude divergence

Diagnosis: ESD Surface **Sure:** 0

Impact: Loss of data until reinitialized **Duration:** Unknown

Category: Upset

Comments: Control processing electronics reinitialized from ground station

References: RSS68

Name: TDRS-1

Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 1 Apr 1992

Description: The Control Processing Electronics stopped running due to CPE/CTE sync failure

Diagnosis: SEU-Cosmic Ray **Sure:** 0

Impact: Unknown **Duration:** Unknown

Category: System Failure

Comments: None

References: RSS54

Name: TDRS-1
Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐
DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐
Dates: 2 Nov 1989
Description: Upset in command processor electronics
Diagnosis: SEU-Cosmic Ray **Sure:** 0
Impact: Temporary loss of attitude control **Duration:** Unknown
Category: Upset
Comments: None
References: RSS49

Name: TDRS-1
Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐
DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐
Dates: 19-20 October 1989
Description: 50 SEUs in radiation susceptible memory chips
Diagnosis: SEU-Solar Proton Event **Sure:** 3
Impact: Unknown **Duration:** 1 day to 1 wk
Category: Degraded Performanc
Comments: Unhardened RAM
References: HCK33

Name: TDRS-7

Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 6 Dec 1995

Description: Loss of attitude control

Diagnosis: SEU-Cosmic Ray **Sure:** 0

Impact: Unknown **Duration** 1 hr to 1 day

Category: Upset

Comments: SEU in the control processing or command and telemetry electronics. An emergency RAM reload did not help and the S/C started to pitch and tumble very quickly as the reaction wheel speeds started dropping

References: RS69

Name: TDRSS

Commercial: ☐ **NASA/NOAA:** ☒ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: After April 1983

Description: Arcing anomalies in several different subsystems over their operating lifetimes, most seriously in the attitude control system processor electronics

Diagnosis: ESD Surface **Sure:** 0

Impact: Rapid manual intervention was required to prevent loss of control of the satellites **Duration** 1 hr to 1 day

Category: Phantom commands

Comments: None

References: RSS16, RSS17

Name: Telecom 1A

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: After 4 Aug 1984

Description: Interrupted data transmissions

Diagnosis: ESD **Sure:** 0

Impact: Mission Loss **Duration** Mission loss

Category: Mission Loss

Comments: Was removed from service and used as a backup

References: RSS10, RSS14

Name: Telecom 1A

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: Various

Description: Switch-off problems in its Syracuse [military communications] payload

Diagnosis: ESD Surface **Sure:** 0

Impact: Intermittent loss of communications **Duration** 1 hr to 1 day

Category: Degraded Performanc

Comments: Electrostatic charge buildup on the satellite's thermal shielding related to an underground metalized dielectric covering that was added at the last minute to cover a fiberglass area of the satellite

References: HCK31

Name: Telecom 1B

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: 15 January 1988

Description: Suffered a failure of both its normal and backup attitude control systems

Diagnosis: ESD Surface **Sure:** 2

Impact: Mission Loss. Relay traffic switched to Telecom 1A. Two of three French TV channels were switched to Telecom 1A **Duration** Mission loss

Category: Mission Loss

Comments: Electrostatic discharges coupling with exposed electrical wiring. At the time of the loss it was the prime platform for the Syracuse military communications relay which was switched to Telecom 1A. Severe magnetic storm on 15 January 1988 with peak Kp of 7.3

References: HCK31, RSS10

Name: Telstar 401

Commercial: ☒ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 9 Oct 1994

Description: Satellite stabilization briefly lost

Diagnosis: ESD Surface **Sure:** 0

Impact: 1-hour disruption in service **Duration** 1 hr to 1 day

Category: Phantom commands

Comments: None

References: RSS1

Name: TEMPO

Commercial: ☒ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 3/25/97

Description: Loss of 2.7 A of Solar Array Current multiple times

Diagnosis: ESD Surface **Sure:** 3

Impact: The problems will result in reduced power toward the end of the satellites projected lifetime **Duration** More than 1 wk

Category: Solar Array Degradati

Comments: The anomalies on 4/11/97 occurred during a large magnetic storm

References: HCK7, HCK8

Name: TOPEX

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☒

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 7 NOV 1993

Description: Failure of the ASTRA 1B star tracker

Diagnosis: ESD Internal **Sure:** 1

Impact: Unknown **Duration** More than 1 wk

Category: System Failure

Comments: None

References: JEM12

Name: TOPEX
Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☒
DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐
Dates: 7 Nov 1993
Description: ASTRA 1A TEC off
Diagnosis: ESD Internal **Sure:** 1
Impact: Unknown **Duration** Unknown
Category: Unknown
Comments: None
References: JEM12

Name: TOPEX
Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☒
DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐
Dates: 13 May 1994
Description: EU anomaly
Diagnosis: ESD Internal **Sure:** 1
Impact: Unknown **Duration** Unknown
Category: Unknown
Comments: None
References: JEM12

Name: TOPEX

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☒

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 25 May 1994

Description: ASTRA 1B star tracker flatline

Diagnosis: ESD Internal **Sure:** 1

Impact: Unknown **Duration** More than 1 wk

Category: System Failure

Comments: None

References: JEM12

Name: TOPEX

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☒

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 4 June 1994

Description: RIU 6A anomaly

Diagnosis: ESD Internal **Sure:** 1

Impact: Unknown **Duration** Unknown

Category: Unknown

Comments: None

References: JEM12

Name: Unknown

Commercial: ☐

NASA/NOAA: ☐

Scientific: ☐

DoD: ☐

Classified/Other: ☒

Foreign: ☐

Dates: 6 October 1981

Description: Premature ignition of a random number of ordnance devices caused subsequent damage to payload during BECO, SECO, MECO1 and MECO2. There was shorting of numerous circuits

Diagnosis: Triboelectric charging of PLF

Sure: 2

Impact: Damage to solar arrays and payload

Duration More than 1 wk

Category: Other

Comments: Charging of fairing surfaces during accent with discharges onto payload causing circuit shorts and premature ordnance ignition on faring and payload. No direct evidence but scenario could explain the fact that damage did occur to antenna, array and payload with several circuits shorted

References: JFF1

Name: Unknown or Classified

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☒ **Foreign:** ☐

Dates: Multiple-Dates unknown

Description: Loss of link and noisy data

Diagnosis: Plasma Effects-Multipaction **Sure:** 3

Impact: Cause loss of data and useless noisy data.
Duration of losses were unpredictable but could last minutes. There were many occurrences. Result was degraded system performance. Design was changed to eliminate problem for follow-on satellites **Duration** 10 min to 1 hr

Category: Degraded Performanc

Comments: Multipaction in classic parallel plate high voltage capacitor in T/M subsystem. Multipaction onset cause by environmental radiation generating free electrons inside the capacitor. Multipaction was duplicated on the ground using a radioactive source to initiate the process.

References: JFF9

Name: Unknown or Classified

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☒ **Foreign:** ☐

Dates: Multiple in 1980

Description: 'Broadband dropout'

Diagnosis: Plasma Effects-Breakdown **Sure:** 2

Impact: Loss of data during dropouts. Operational workaround required. Vents were redesigned to fix problem on later S/C **Duration** Unknown

Category: Degraded Performance

Comments: Ion ingestion caused sputtering of High Voltage terminals and subsequent breakdown with loss of output from TWTs. Subsequent operations were designed to minimize ram ion ingestion with good success. References discuss problem and not actual anomaly

References: JFF5, JFF6, JFF7

Name: Unknown spacecraft

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☒ **Foreign:** ☐

Dates: 6, 8, 9, 14th Mar 89

Description: Episodes of uncontrolled tumbling

Diagnosis: Unknown **Sure:** 0

Impact: Interfered with operational functions **Duration** Unknown

Category: Unknown

Comments: Great Storm Period

References: JHA15

Name: Unknown. Identified as F3

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☒ **Foreign:** ☐

Dates: 8-10 September 1982

Description: Telemetry anomalies near perigee on 4 occasions

Diagnosis: ESD Internal **Sure:** 2

Impact: Unknown **Duration** Unknown

Category: Spurious Signal

Comments: Report covers multiple satellites in the same HEO orbit with 'telemetry' anomalies. Same as Unknowns F2 and F4. Multiple satellites had anomalies on same days

References: JFF3

Name: Unknown. Identified as F4

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☒ **Foreign:** ☐

Dates: 8-10 September 1982

Description: Telemetry anomalies on 3 occasions

Diagnosis: ESD Internal **Sure:** 2

Impact: Unknown **Duration** Unknown

Category: Spurious Signal

Comments: Report covers multiple satellites in the same HEO orbit with 'telemetry' anomalies. Same as Unknowns F2 and F3. Multiple satellites had anomalies on same days

References: JFF3

Name: Unknown. or Classified Identified as F2

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☒ **Foreign:** ☐

Dates: 10 September 1982

Description: Telemetry anomalies near perigee

Diagnosis: ESD Internal **Sure:** 2

Impact: Unknown **Duration:** Unknown

Category: Spurious Signal

Comments: Report covers multiple satellites in the same HEO orbit with 'telemetry' anomalies. Same as Unknowns F3 and F4. Multiple satellites had anomalies on same days

References: JFF3

Name: UOSAT 2

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: After Feb 1984

Description: Upsets in large dynamic NMOS and static CMOS memories

Diagnosis: SEU-South Atlantic Anomaly **Sure:** 3

Impact: Unknown **Duration:** Unknown

Category: Upset

Comments: Upsets in large dynamic NMOS and static CMOS memories, strongly localized to the South Atlantic region

References: RSS52

Name: UOSAT 2

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☒

Dates: 19-29 October 1989

Description: Many SEUs particularly in the South Atlantic Anomaly Region

Diagnosis: SEU-South Atlantic Anomaly **Sure:** 0

Impact: Unknown **Duration:** Unknown

Category: Upset

Comments: None

References: HCK33

Name: Vehicle 4487

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☐

DoD: ☒ **Classified/Other:** ☐ **Foreign:** ☐

Dates: 08 Aug 95

Description: Redundant attitude control system (ACS) failed to acquire the sun

Diagnosis: ESD **Sure:** 2

Impact: Unknown **Duration:** More than 1 wk

Category: System Failure

Comments: None

References: SWS1

Name: Viking Lander 1

Commercial: ☐

NASA/NOAA: ☐

Scientific: ☒

DoD: ☐

Classified/Other: ☐

Foreign: ☐

Dates: After Aug 1975

Description: Variations in Gas Chromatograph Mass Spectrometer Ion Pump current

Diagnosis: ESD

Sure: 0

Impact: Operations with a degrading high voltage source

Duration More than 1 wk

Category: Degraded Performanc

Comments: Arcing/corona

References: RSS28

Name: Voyager 1

Commercial: ☐

NASA/NOAA: ☐

Scientific: ☒

DoD: ☐

Classified/Other: ☐

Foreign: ☐

Dates: 1979

Description: An on-board clock lost 8 seconds due to 40 spurious power-on reset signals

Diagnosis: ESD

Sure: 0

Impact: Unknown

Duration Unknown

Category: Degraded Performanc

Comments: Jovian Radiation

References: RSS38

Name: Voyager 1

Commercial: ☐ **NASA/NOAA:** ☐ **Scientific:** ☒

DoD: ☐ **Classified/Other:** ☐ **Foreign:** ☐

Dates: After Sep 1977

Description: Star tracker number 2 could not be commanded into cone angle settings 2, 4, or 5

Diagnosis: Radiation Damage **Sure:** 0

Impact: Unknown **Duration** More than 1 wk

Category: Random Part Failure

Comments: Transistor leakage caused by 2 or more Delrin insulating sleeves decomposing due to high intensity radiation

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